THE ARCHAEOLOGY AND PALAEOENVIRONMENT OF BALTMOOR WALL, SOMERSET LEVELS: THE LOWER TONE FLOOD DEFENCE SCHEME, 1996–2002

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With contributions by Nigel Cameron, A.G. Collings, David Robinson and Vanessa Straker

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Observations and palaeoenvironmental samples were taken during engineering works to Baltmoor Wall, a medieval flood defence embankment between East Lyng and Athelney Hill, Somerset. Pottery recovered from beneath Baltmoor Wall indicates construction of the embankment in the 14th or 15th century, agreeing with the historical evidence. Evidence for an early medieval bank and ditch was also recorded, the earliest known excavated features from Athelney Hill. A number of samples taken through the Holocene sequence of alluvial silts and peat were assessed for their palaeoenvironmental potential with regard to their pollen, diatom, foraminifera and plant macrofossil content. All of these profiles were dated to either the 2nd millennium BC (Bronze Age), or 1st millennium AD (Roman to medieval), and two profiles, one from each of these periods, were selected for detailed analysis.

The results show that, throughout the Bronze Age, the surrounding environment was dominated locally by woodland, with oak, hazel, lime and ash. The depositional environment changed from a grass/sedge fen in the early-middle Bronze Age to a wetland carr woodland, regressing to a grass-sedge fen in later Bronze Age, possibly due to widespread positive eustatic changes. Retrieved late Bronze Age timbers may have come from a trackway, perhaps constructed in response to the increasing local wetness. The presence of cereal pollen indicates a general background of arable agriculture throughout the sequence, but probably not in the immediate vicinity.

A similar depositional sequence was apparent from the 1st millennium AD, with a grass/sedge fen of the early Roman period giving way to a drier swamp and ultimately alder carr environment, but which in the 11th to 12th century also regressed back to a wetter floodplain, possibly with episodes of marine incursion. Water management by the monks of Athelney Abbey from the 12th century onwards probably contributed. The local environment was dominated by herbs and grasses with few trees and shrubs. Pollen evidence again indicates a general background of arable agriculture and some evidence for increasing pasture. Thick deposits of colluvium recorded over the early medieval bank and ditch appear to provide firm evidence for soil erosion on Athelney Hill, probably due to arable farming following the founding of the abbey in the late 9th century AD.

INTRODUCTION

Between August 1996 and July 2002, Cotswold Archaeology (CA) and Exeter Archaeology (EA) carried out a programme of archaeological work in the vicinity of Baltmoor Wall, East Lyng, Somerset (centred around ST 341292; Figure 1). This was undertaken during an extended programme of investigation and consolidation of parts of the Lower Tone Flood Defence Scheme. Archaeological fieldwork was focused around Baltmoor Wall, a flood defence embankment that runs between East Lyng and Athelney Hill (Figure 2). The archaeological fieldwork was commissioned by the Environment Agency through consultants Posford Haskoning, and was undertaken to satisfy the requirements of planning permission (ref: 1/32/99/5) and Scheduled Monument Consent (refs: HSD9/2/2587pt6; HSD9/2/161pt5; HSD9/2/4300pt5). All fieldwork was undertaken in accordance with various briefs prepared by Richard Brunning, Levels and Moors Archaeologist, Somerset County Council, and with *General Specification for Archaeological Work in Somerset* (Somerset County Council 1995).

The results of each phase of fieldwork were reported upon in a series of unpublished typescript reports (Collings *et al* 1996; Vartuca 1999; CAT

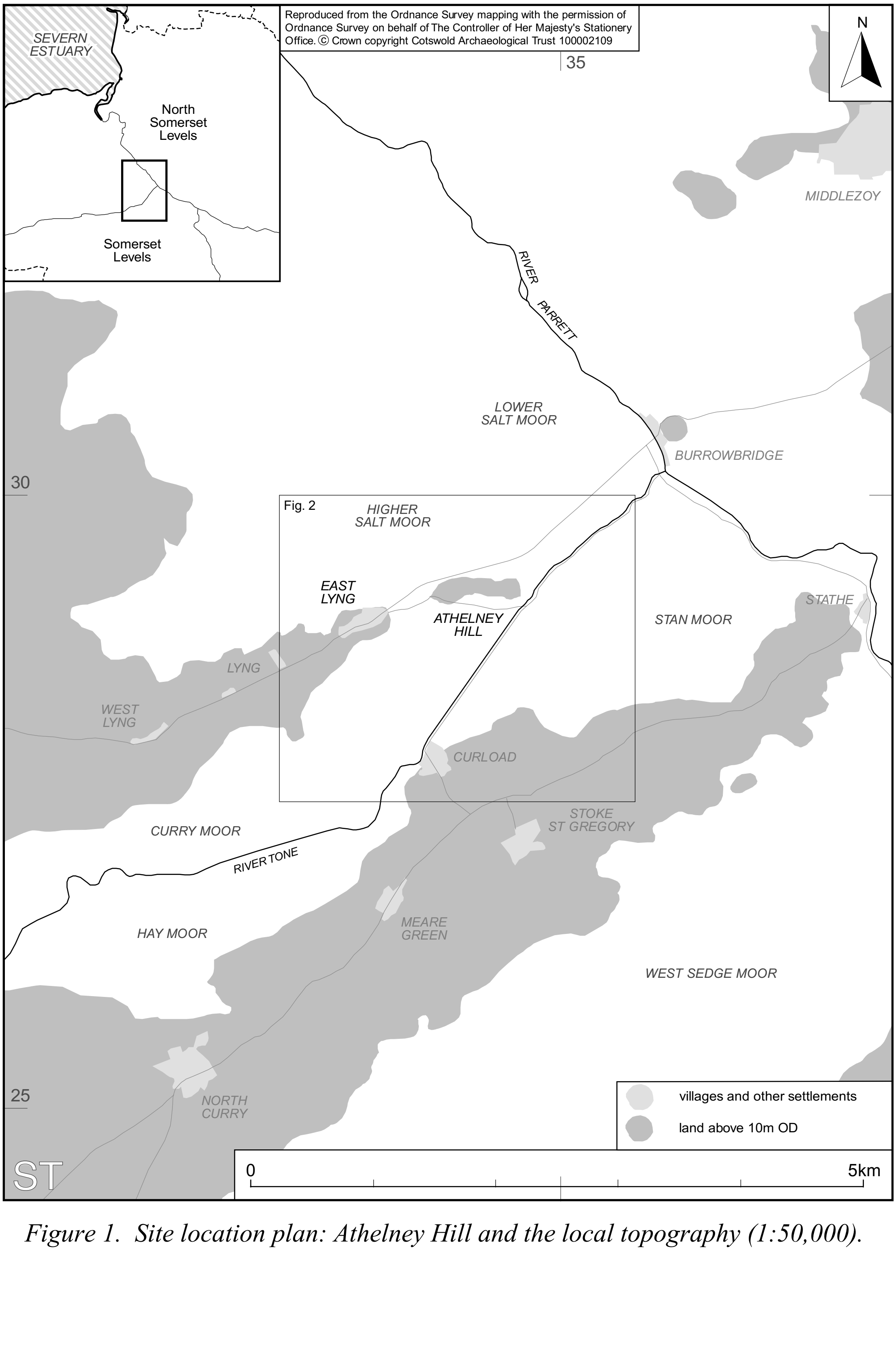


Figure 1. Site location plan: Athelney Hill and the local topography (1:50,000).

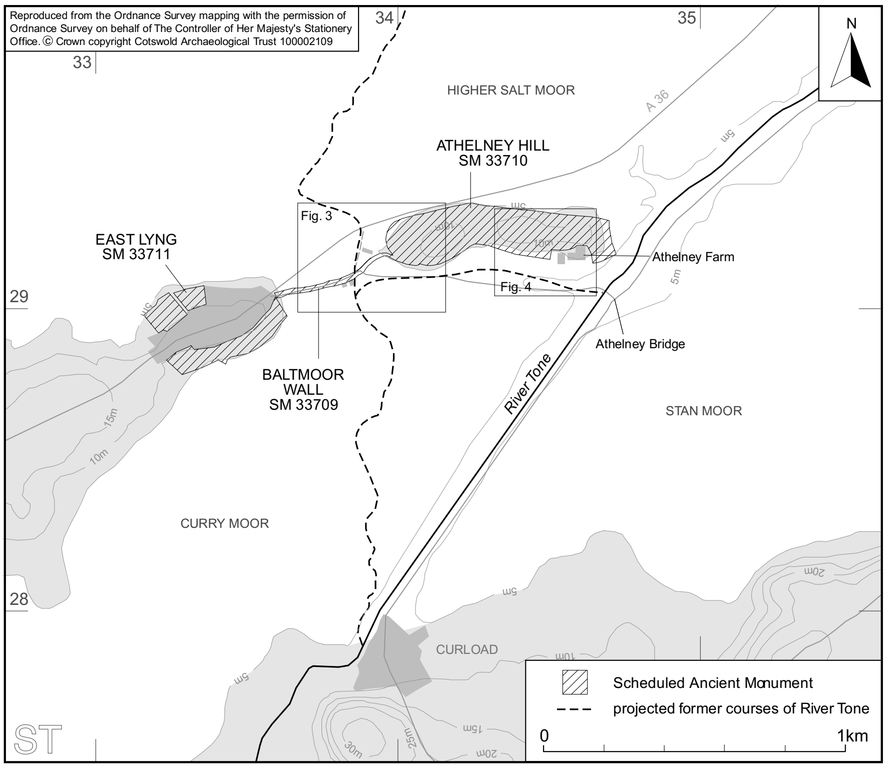


Figure 2. Site location plan: Scheduled Ancient Monuments and projected former water courses (1:25,000).

2001a; CAT 2001b; Reed 2002; CA 2002a; CA 2002b). A number of samples were taken for their palaeoenvironmental potential during the course of fieldwork, including monolith samples from trial trenches and samples taken from borehole cores through deposits of mineral sediment and peat, from which some radiocarbon dates were obtained. On completion of fieldwork an assessment was undertaken by Dr Robert Scaife of the potential of the various palaeoenvironmental samples recovered to inform on past environments, with particular reference to profiles relating to locally significant archaeological remains and/or historical events. Assessment analyses produced preliminary pollen diagrams and data on the presence/absence of diatoms and foraminifera. Four profiles demonstrated that well preserved pollen and diatoms were present in all or parts of the columns, but that foraminifera were largely absent.

Following assessment, detailed pollen analysis of two selected profiles (borehole BH1D and section TT1) was carried out by Dr Robert Scaife, in conjunction with further radiocarbon dating and examination of the plant macrofossils by Dr David Robinson. Diatoms have also been examined by Dr Nigel Cameron where they survive within the more minerogenic sediments from borehole BH1D. The significant results of both fieldwork and palaeoenvironmental analyses are discussed (including the pollen profiles prepared to assessment stage only), and the results are considered in their local and regional context.

The site

Baltmoor Wall is a flood-defence embankment that lies to the north of the River Tone within the Somerset Levels, approximately 18 km from the present-day coastline. The embankment runs eastwards from the eastern end of the village of East Lyng for 550 m to the western end of Athelney Hill. At the eastern end of Athelney Hill, another flood-defence embankment runs south and then east from Athelney Farm for another 320 m, joining the floodbank of the River Tone at Athelney Bridge. With Athelney Hill, the embankments form a continuous, kilometre-long barrier from East Lyng to the canalised Tone, between Salt Moor to the north and Curry Moor to the south. Athelney Hill is at 12 m OD, the crest of Baltmoor Wall stands at about 8 m OD, and the surrounding moors lie at about 4–5 m OD.

Baltmoor Wall, believed to be of medieval origin, is a Scheduled Ancient Monument (no. 33709), as are Athelney Hill (no. 33710; the site of Anglo-Saxon occupation and Athelney Abbey) and East Lyng (no. 33711; the site of an Anglo-Saxon burh).

Historical and archaeological background
A.G. Collings and Martin Watts

The area around Athelney is rich in historical associations, most notably with that of King Alfred, but so few documents survive from the early medieval period it is rarely possible to provide confirmation of statements. Smyth (1995a) has cast considerable doubt on the accuracy of the allegedly contemporary biography of the king by Asser, and in particular is dismissive of the unchallenged view that Alfred founded Athelney Abbey in gratitude to God for his victory over the Danish king Guthrum at Edington in AD 878. However, there exists a (seemingly genuine) charter in which King Athelstan, Alfred's grandson, granted land to the church of St Peter at Athelney, said to have been built by his grandfather (Finberg 1964, 130–1). This would seem to refer to the monastery church, dedicated to 'Our blessed Saviour, St Peter, St Paul and St Athelwine' (Page 1911, 99); the parish church at Lyng has been dedicated to St Bartholomew since at least 1531 (Dunning 1992, 63). Investigations undertaken by the 'Time Team' programme in 1993 confirmed the location of Athelney Abbey at the eastern end of the hill (around the 19th–century abbey monument), primarily through geophysical survey, which identified buried structural remains relating to the Norman and later rebuilding of the abbey (recorded on the Somerset Historical Environment Record (HER) as Primary Record Number (PRN) 11620).

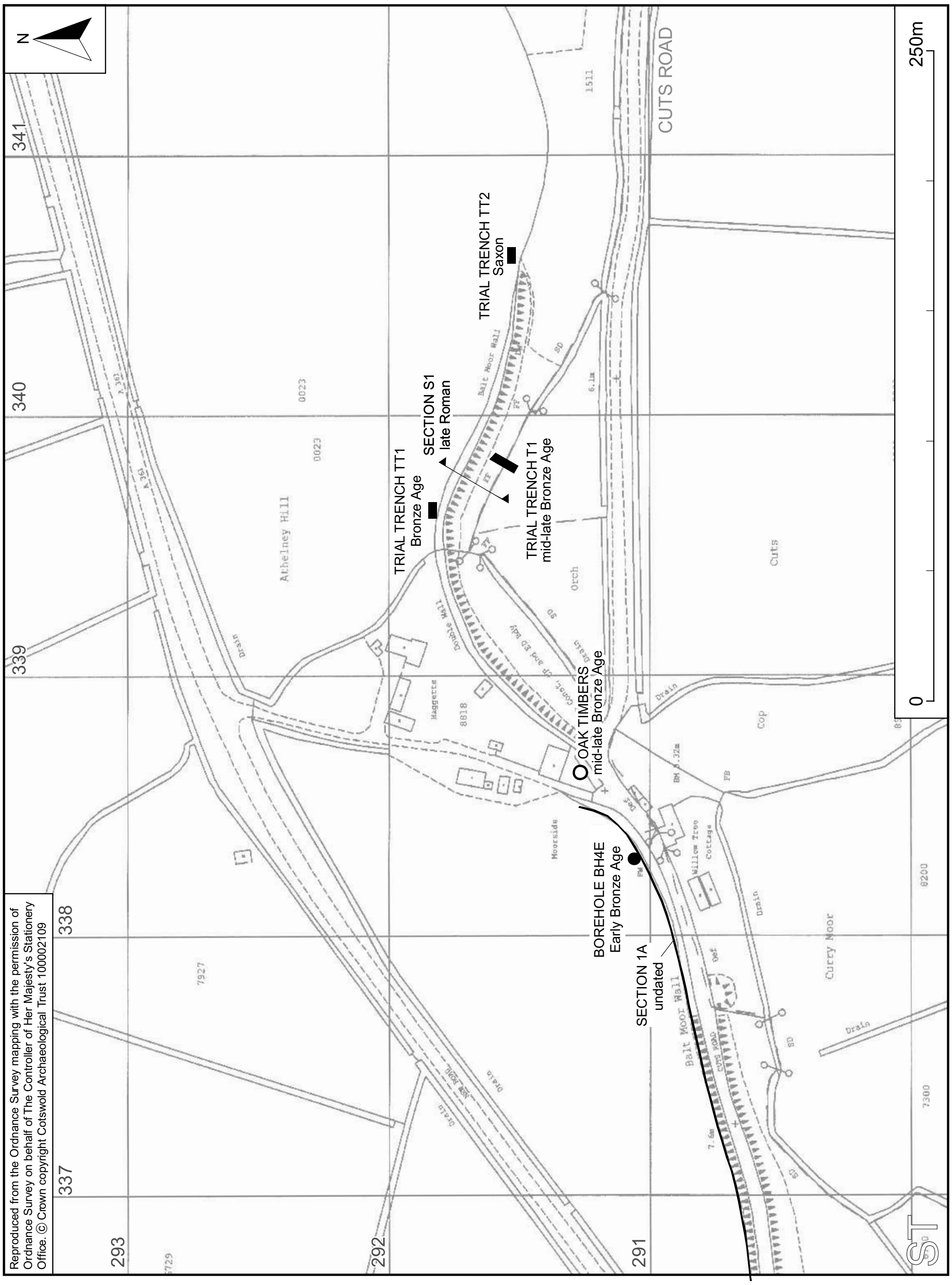
The earliest known reference to Athelney is the *Anglo-Saxon Chronicle* for AD 878, which relates that 'King Alfred with a small company, built a fortification at Athelney, and from that fortification, with the men of that part of Somerset nearest it, he continued fighting the host'. This fortification is generally assumed to be at the western end of Athelney Hill. It was probably an earthen structure consisting of a ditch and bank with palisade fence (Costen 1992, 112) and a circular enclosure has been detected by aerial photography. Geophysical survey undertaken by 'Time Team' in 2002 identified possible enclosure ditches but no clear plan of the fort was obtained. Some ditches were filled with ferruginous material that, along with the finding of a piece of slag, implies early industrial activity (Webster and Croft 1993, 142).

A better-substantiated fort (or fortified burh) at East Lyng is referred to in the Burghal Hidage from around AD 915 (Smyth 1995b, 135), the remains of which are identifiable as current landscape features (Hill 1967, 64–6). Translations of Alfred's 'alleged' biography by Asser mention two fortresses and make reference to a wooden bridge or causeway built between (Hill 1967, 64; Keynes and Lapidge 1983, 103, 271). A bridge would have been necessary to cross an earlier course of the Tone that flowed between East Lyng and Athelney Hill, with only a minor channel running eastwards, to the south of the hill (Fig. 2). Excavations and geophysical survey in 1995 also found evidence for Romano-British activity south of East Lyng on the edge of Curry Moor (PRN 16156).

Baltmoor Wall appears to have been built by the monks of Athelney Abbey as part of a water management scheme to reclaim land to the north. A charter from the reign of Stephen (Bates 1899, 168) indicates that water management was being undertaken by the monks in the mid 12th century. Williams (1970, 59) suggests a date of 1374–5 for the major diversion of the Tone to the east of Athelney Hill by a nearly straight embanked channel some 1.25 km long (Figure 2), and that the construction of Baltmoor Wall was the final stage in the flood prevention system. It is generally accepted that Baltmoor Wall dates from the 14th century, possibly on the site of the earlier bridge or causeway (Aston and Leech 1977, 87).

There are few post-medieval references to Baltmoor Wall. In 1675, there was concern over the costs of an order that 'Bullsmore Wall be faced with stone to save the country from sudden floods' (Somerset Record Society 1919, 183–4). The Wall carried the Taunton to Wells road until a new turnpike road was constructed to the north at the beginning of the 19th century (Dunning 1992,

Figure 3 (right). Location of significant archaeological interventions; west (1:2500).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N
TRIAL TRENCH TT2
Saxon
SECTION S1
late Roman
TRIAL TRENCH TT1
Bronze Age
TRIAL TRENCH T1
mid-late Bronze Age
OAK TIMBERS
mid-late Bronze Age
BOREHOLE BH4E
Early Bronze Age
SECTION 1A
undated
CUTS ROAD
Athelney Hill
Salt Moor Wall
Curry Moor
Cuts
337
338
339
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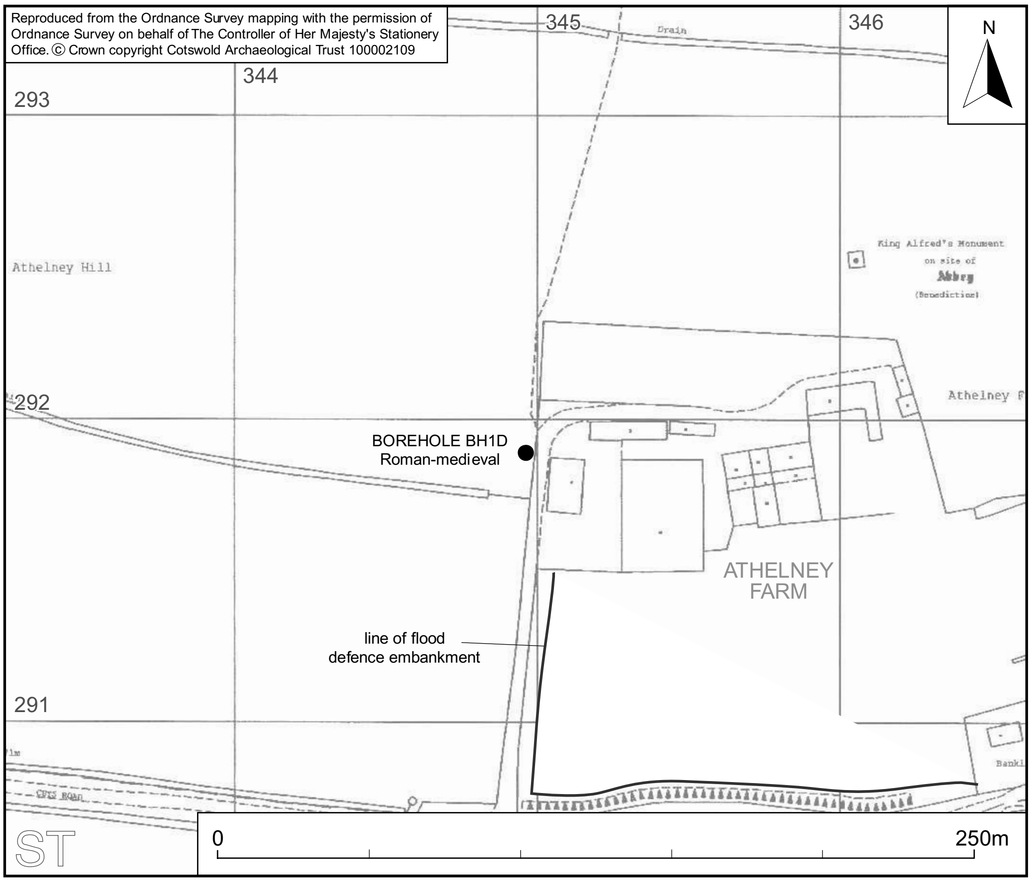

Figure 4. Location of significant archaeological interventions; east (1:2500).

54). In 1883 it was encased in masonry on the orders of the Somerset Drainage Commissioners. Flooding in the 20th century led to works being undertaken in 1961, when the whole length of the wall was raised and strengthened. Emergency repairs and further strengthening works were also undertaken following serious flood levels in 1995.

FIELDWORK AND SAMPLING
Martin Watts

Fieldwork involved the monitoring and observation of numerous geotechnical boreholes, trial pits and machine-excavated sections, seven of which yielded significant results. Most of these significant interventions were located in the vicinity of Baltmoor Wall except for borehole BH1D, which was sunk about 450 m to the east at Athelney Farm. The locations of these interventions are shown on Figures 3 and 4; an overview of the fieldwork is provided in Table 1.

Fieldwork commenced in 1996 with the excavation of a section (**S1**) across Baltmoor Wall (Figure 5), the crest of which stands at over 2 m above present ground level. At the bottom of the exposed sequence, a 0.15 m-thick layer of alluvial sediment (513) containing some burnt material lay over natural gravels and was sealed by a 0.1 m-thick peat horizon (512), at *c* 1.4 m below ground level. Peat horizon 512 was radiocarbon dated to 230–440 Cal AD (WK16611). Above lay a thick deposit of alluvial sediment (510) sealed by a buried soil horizon (508) at *c* 0.5 m below ground level. Monolith samples were taken through deposits 508, 510, 512 and 513; those through deposit 508 did not survive. To the south, a deposit of alluvial silt (511, presumably within a palaeochannel) was found to contain two sherds of green-glazed pottery dating to the 14th or 15th century. The original earth bank of Baltmoor Wall (506) was constructed over both the alluvium 511 and buried soil 508. The wall was later encased in stonework (503), supported by clay bedding deposits (504, 505), with modern silt deposits (501, 507) overlying the wall to either side (Collings *et al* 1996).

Further fieldwork in 1998 included the recording of two trial trenches and a number of

Table 1. Archaeological interventions at Baltmoor Wall, 1996–2002.

Date	By	Description	Samples taken	C14 lab no.	Deposit(s)	For	Of
1996	BMW 1996 Exeter Arch.	**Section S1** through Baltmoor Wall; 3 boreholes; 6 trial pits	**S1:** monoliths 301A and B		Buried soil 508 under bank; alluvial soil 510; peat 512	**assessment only**	pollen; diatoms; forams
			S1: C14	**WK16611**	peat 512		
1998	BMW 1998 Exeter Arch.	2 trial trenches (**TT1**; **TT2**); 40 boreholes (including **BH1D**; **BH4E**)	**TT1:** monoliths 1 and 2		colluvium/ alluvium; peat; alluvium	**FULL ANALYSIS**	pollen; plant macros
			TT1: C14	**AA33142**	top of peat		
			TT1: C14	**WK16612**	bottom of peat		
			TT2: bulk sample		upper fill of ditch	**assessment only**	charred plant remains
			TT2: C14	**AA33140**	charred grain in ditch		
			TT2: C14	**AA33141**	charcoal layer beneath bank		
			BH1D: core samples		silt; silty peat; peat; humic silt	**FULL ANALYSIS + assessment**	pollen; plant macros; diatoms + forams
			BH1D: C14	**AA33139**	top of silty peat		
			BH1D: C14	**WK16763**	bottom of peat		
			BH4E: core samples		alluvium; peat	**assessment only**	pollen; diatoms; forams
			BH4E: C14	**AA33143**	top of peat		
			BH4E: C14	**WK16764**	bottom of peat		
1999	BWM 99. Cotswold Arch.	badger setts; victorian wall; test slot; 2 trial trenches	**T1:** C14	**WK7950**	peat 102		
2001	BAW 01. Cotswold Arch.	trench for sheet piles; other landscaping	**1A:** 2 monoliths and a bulk sample		alluvium 1008; peat 1009; alluvium 1010	**assessment only**	pollen; diatoms; forams
2002	Richard Brunning	wood from spoilheap next to west side of Moorside Cottage	**Oak:** C14	**WK10685**	2 oak piles and an oak plank, all unstratified		

boreholes, two of which were selected for palaeoenvironmental sampling. In Trial Trench 1 (**TT1**), a 0.32 m-thick layer of peat was exposed at 1.55 m below ground level (4.4 m OD). The top of the peat was radiocarbon dated to 1370–920 Cal BC (AA33142); the bottom to 2140–1890 Cal BC (WK16612). The peat overlay alluvial clay, the full depth of which was not exposed, and was sealed by a silty peat deposit and over 1 m of colluvial/alluvial clay. Over this lay *c* 0.3 m of modern silt deposits, and topsoil. Monolith samples were taken through the peat deposits and underlying alluvium. Trial Trench 2 (**TT2**) was located at the eastern end of the visible remains of Baltmoor Wall. Natural deposits were sealed by two layers of buried soil and a very thin charcoal lens, over which a low (0.2 m-high), east/west-aligned bank had been constructed (Figure 6). The top of the bank stood at 1.6 m below ground level (6.1 m OD). The bank was truncated to the east by a (probable) north/south-aligned ditch, the base of which was not exposed. The upper fill of the ditch was sampled for charred plant remains; their analysis by Vanessa Straker is reproduced in full (below). The charcoal lens beneath the low bank was radiocarbon dated to 430–670 Cal AD (AA33141); the upper fill of the ditch to 590–780 Cal AD (AA33140). Above the bank and infilled ditch lay two substantial deposits of colluvium, thickening towards the north, and further modern

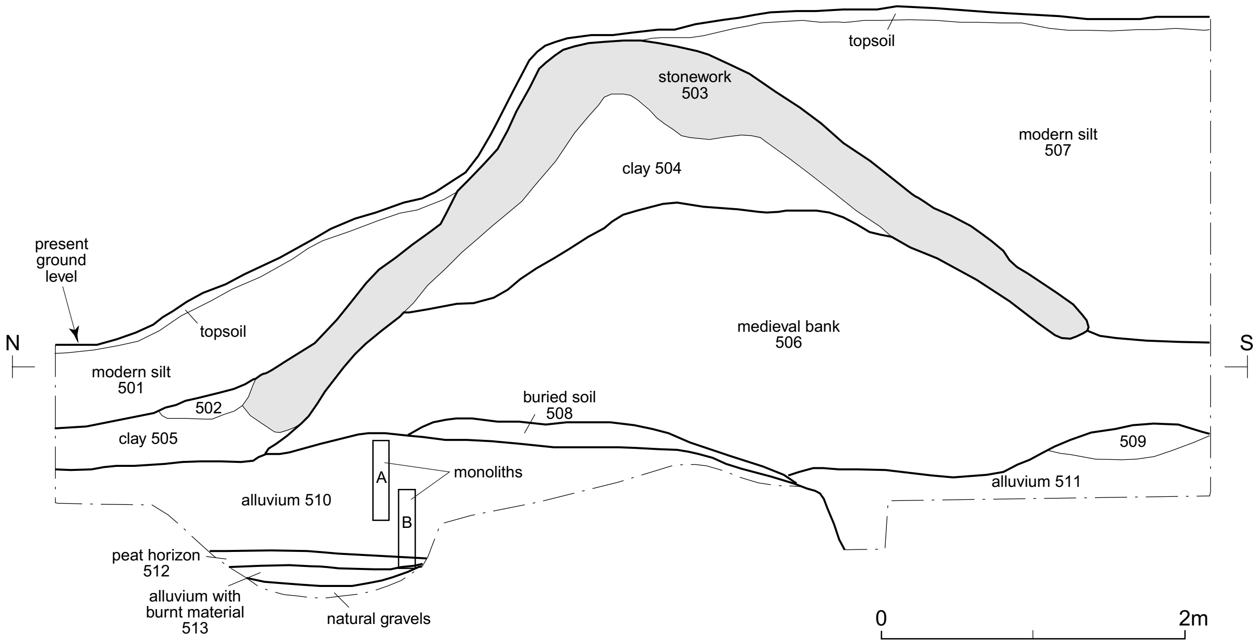

*Figure 5. Section **S1** through Baltmoor Wall. Datum height arbitrary (reproduced from Collings* et al *1996; 1:50)*

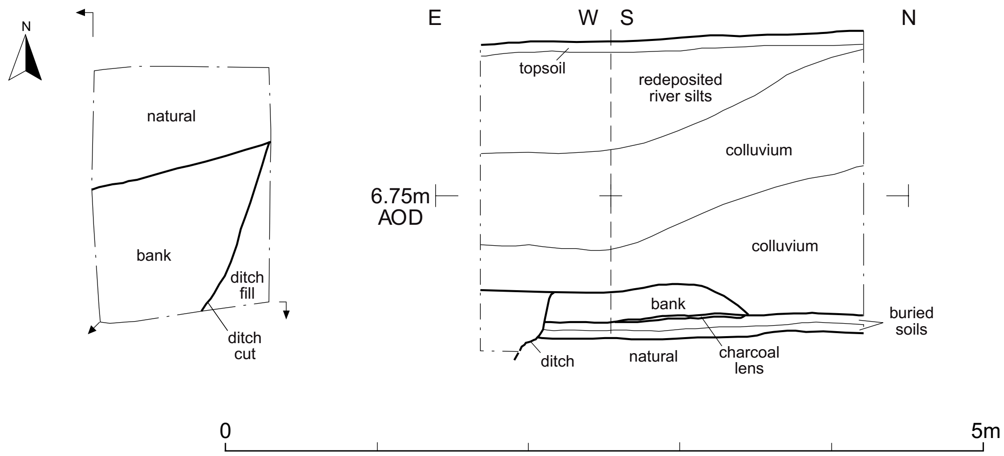

*Figure 6. Trial Trench **TT2**, plan and section of Saxon bank and ditch (reproduced from Reed 2002; 1:50).*

silt deposits (Reed 2002).

Samples were also taken from the cores of two boreholes, **BH1D** and **BH4E**, both of which contained substantial peat deposits, for palaeoenvironmental analysis. Borehole **BH1D** contained a peat deposit approximately 0.38 m thick, the top of which was located at *c* 2.43 m below ground level (3.57 m OD). The top of the peat was radiocarbon dated to 1020–1230 Cal AD (AA33139); the bottom to 70–260 Cal AD (WK16763). Borehole **BH4E** was located adjacent to Baltmoor Wall and contained a 0.44 m-thick peat deposit, the top of which occurred at *c* 1 m below ground level (3.9 m OD). The top of the peat was radiocarbon dated to 2130–1750 Cal BC (AA33143); the bottom to 2140–1910 Cal BC (WK16764) (Reed 2002).

In 1999, a further trial pit (**T1**) exposed a peat deposit at least 0.5 m thick, the top of which was located at 1.3 m below ground level (4.3 m OD). The peat was radiocarbon dated to 1020–800 Cal BC (WK7950); no samples were taken (Vartuca 1999). In 2001, layers of peat and alluvium were exposed during construction work in section (**1A**), the vicinity of BH4E. The top of the 0.4 m-thick peat deposit (1009) lay at 1 m below ground level (3.9 m OD). Two monolith samples were taken but the peat was not dated

Figure 7. An exposed length of Baltmoor Wall stonework in the vicinity of BH4E, looking north-east, scale 1 m.

(CAT 2001b), although its proximity to BH4E and identical top height strongly suggested contemporaneity.

During construction work several lengths of the stonework facing and capping to Baltmoor Wall were exposed and recorded photographically (Figure 7). The final significant discovery during fieldwork was made by Richard Brunning in 2002, who retrieved the remains of two oak piles and an oak plank, clearly excavated from some depth, from a spoilheap in the vicinity of Moorside Cottage. The wood was radiocarbon dated to 1370–1010 Cal BC (WK10685).

RADIOCARBON DATING

Martin Watts

Ten samples were sent for radiocarbon dating from a number of horizons from different interventions, and from the unstratified oak timbers. The primary purpose of the dating programme was to provide a chronological framework for the interpretation of the various analyses. To this end, radiocarbon determinations were obtained from the top and base of the peat deposits identified within boreholes BH1D and BH4E, and section TT1, as these locations provided the widest range available using material suitable for this dating technique. Single determinations were also obtained for the peat deposits in sections S1 and T1, and from below the bank and within the ditch recorded in section TT2 in order to date those specific features.

The AA samples were submitted to the Scottish Universities Research and Reactor Centre (SURRC) for preparation for accelerator radiocarbon dating at Arizona University AMS facility, Tucson, Arizona. The WK samples were processed for radiometric radiocarbon dating at the University of Waikato Radiocarbon Dating Laboratory, Hamilton, New Zealand. The results are conventional radiocarbon ages (Stuiver and Polach 1977). A number of different calibration programs were used to obtain calendar years during the course of fieldwork and assessment: all of the conventional radiocarbon ages (BP) have now been calibrated to calendar years using the calibration curve of Reimer *et al* (2004) and the computer program OxCal 3.10 (Bronk Ramsey 2005). Details of the results and calibrated dates are presented in Table 2. Date ranges cited in the text are those at 95.4% confidence level unless otherwise specified. The calibrated dates for horizons within pollen profiles are shown on Figures 9 to 15.

STRATIGRAPHY

Robert Scaife and David Robinson

The stratigraphy and character of the sediments selected for palaeoenvironmental analysis were described in the laboratory from the examination of the sample columns and sequential samples taken in the field. The results, with radiocarbon dates where applicable, are given in Table 3.

POLLEN ANALYSIS

Robert Scaife

Assessment of pollen content was carried out on profiles from boreholes **BH1D** and **BH4E**, and from sections **1A** and **S1**; a further profile (from section **TT1**) was subsequently examined. Of these profiles, **BH1D** (with sediments spanning the Roman to medieval periods) and **TT1** (spanning the 2nd millennium BC) were selected for fuller analysis as they relate to other archaeological data of local significance. Data obtained from the assessment of profiles **BH4E** and **1A** (both early Bronze Age) and **S1** (late Roman) is of interest and has been incorporated into this report where appropriate. Results from the profiles are presented in chronological order.

Pollen Method

Samples of 2 ml volume were taken from the core and monolith samples. These were prepared using

Table 2. Radiocarbon dates from Baltmoor Wall.

Lab no.	Description	Height (OD)	Material	Radiocarbon Age (BP)	Calibrated date range (95.4% confidence)
AA 33139	**BH1D:** top of peat	*c 3.57 m*	Peat: Humic acid	900 +/- 50	AD 1020 - AD 1230
AA 33140	**TT2:** Grain from ditch	*c 6.00 m*	charred grain	1355 +/- 50	AD 590 - AD 780
AA 33141	**TT2:** Charcoal beneath bank	*c 5.95 m*	charcoal	1460 +/- 50	AD 430 (5%) AD 490 AD 530 (90.4%) AD 670
AA 33142	**TT1:** top of peat	*c 4.40 m*	Peat: Humic acid	2925 +/- 70	1370 BC (2%) 1340 BC 1320 BC (93.4%) 920 BC
AA 33143	**BH4E:** top of peat	*c 3.90 m*	Peat: Humic acid	3585 +/- 55	2130 BC (5.1%) 2080 BC 2050 BC (90.3%) 1750 BC
WK7950	**T1:** peat 102	*c 4.20 m*	Peat: plant fragments	2760 +/- 50	1020 BC - 800 BC
WK10685	**Oak** from spoilheap	*not recorded*	wood	2959 +/- 52	1370 BC (2.8%) 1340 BC 1320 BC (92.6%) 1010 BC
WK16611	**S1:** monolith 302 from peat 512	*not recorded*	Peat: plant fragments	1690 +/- 43	AD 230 - AD 440
WK16612	**TT1:** bottom of peat	*c 4.10 m*	Peat: plant fragments	3636 +/- 43	2140 BC - 1890 BC
WK16763	**BH1D:** bottom of peat	*c 3.23 m*	Peat: plant fragments	1839 +/- 39	AD 70 - AD 260
WK16764	**BH4E:** bottom of peat	*c 3.48 m*	Peat: plant fragments	3637 +/- 32	2140 BC (14.9%) 2080 BC 2060 BC (80.5%) 1910 BC

standard procedures for the extraction of sub-fossil pollen and spores (Moore and Webb 1978; Moore *et al* 1991). Where preservation allowed, for those profiles selected for fuller analysis (**TT1** and **BH1D**) pollen counts of up to 600 grains per level were made; for those profiles taken to assessment only, pollen counts of 200 grains per level were counted. Counts were also made of all marsh/aquatic taxa spores of ferns and miscellaneous microfossils, including derived geological palynomorphs and Holocene algal *Pediastrum*. Identification was carried out using an Olympus biological research microscope fitted with Leitz optics and phase contrast. Laboratory work was carried out in the Department of Geography, University of Southampton. Data obtained from these counts are presented in standard pollen diagram form (Figures 8–14) with percentages calculated as follows:

Sum = % total dry land pollen (tdlp)
Alnus = % Sum + *Alnus glutinosa*
Marsh/aquatic = % Sum + sum of marsh/aquatics
Spores = % Sum + sum of spores
Misc. = % Sum + sum of miscellaneous taxa

Alnus glutinosa (alder) has been excluded from the pollen sum because of its high pollen productivity (and its consequent abundance) and its on- or near-site growth, which tends to distort the percentage representation of other taxa within the pollen sum (Janssen 1969). Consequently the percentages of alder have been incorporated within the fen/marsh group, to which it belongs to botanically. Because *Salix* (willow) may be associated with this fen carr habitat, this was also included in the marsh/wetland category. The high pollen productivity of *Alnus glutinosa* will also have had an influence on the taphonomy of the pollen. This woodland type will have restricted the pollen input from the adjacent dry land of the interfluves and islands within the Levels. This filtering effect was originally discussed by Tauber (1965) and is important here since it may specifically affect the interpretation of the less well represented woodland trees such as lime (*Tilia*) and ash (*Fraxinus excelsior*).

The calculations and the pollen figures were made using Tilia and Tilia Graph Taxonomy (Grimm 1991), and in general follow the practice of Moore and Webb (1978), modified according to Bennett *et al* (1994) for pollen types, and Stace (1991) for plant descriptions.

The inferred vegetation is discussed in terms of two components. First are the on-site, autochthonous plant communities which contributed to the marsh and aquatic pollen component and provide evidence of the changing

Table 3. Borehole and section stratigraphy from Baltmoor Wall, with radiocarbon dates. Depth is below ground level; colour codes are from a standard Munsell chart

Section	Depth (cm)	Height OD	Description	Radiocarbon date	Lab no.
BH4E	90–92	3.98–4.00 m	Yellow-brown silt 10YR5/6 or 5/8		
	92–100	3.90–3.98 m	Dark grey humic silt 10YR4/3 or 4/2		
	100–144	3.46–3.90 m	Black detrital (oxidised?) peat with some silt. 10YR 2/2	top: 2130-1750 Cal BC	AA 33143
				bottom: 2140-1910 Cal BC	WK 16764
	144–156	3.34–3.46 m	Humic, grey/brown silt 10YR5/2. Transition		
	156 –161	3.29–3.34 m	Pale grey medium silt 10YR 6/2		
1A	75–89	4.01–4.15 m	Pale grey silt/clay		
	89–100	3.90–4.01 m	Peaty silt. Disturbed transition?		
	100–138	3.52–3.90 m	Detrital, black humified peat with small twig fragments		
	138–145	3.45–3.52 m	Red, silty clay. Homogeneous (5YR 4/2)		
TT1	147–155	4.40–4.48 m	Grey/black silty peat		
	155–187	4.08–4.40 m	Red-brown coarse woody peat	top: 1370-920 Cal BC	AA 33142
				bottom: 2140-1890 Cal BC	WK 16612
	187–197	3.98–4.08 m	Grey silty clay		
S1	144–150	(not recorded)	Dark, detrital humic peat.	230-440 Cal AD	WK 16611
	150–156	(not recorded)	Grey-brown alluvial clay/silt (10YR 3/2)		
BH1D	188–193	4.07–4.12 m	Brown silt (10YR 4/3)		
	193–200	4.00–4.07 m	Yellow/brown silt (10YR 4/3)		
	200–240	3.60–4.00 m	Grey silt, slightly gleyed (10YR 3/3 or 4/4)		
	240–252	3.48–3.60 m	Grey silt/black peat transition	top: 1020-1230 Cal AD	AA 33139
	252–278	3.22–3.48 m	Black detrital fen-type peat	bottom: 70-260 Cal AD	WK 16763
	278–292	3.08–3.22 m	Dark humic silt (10YR 3/2 to 4/2)		

status of the wetland. Second, is the dry land pollen component (the pollen sum) which provides evidence of the past woodland, its clearance and subsequent agricultural activity.

Borehole BH4E (Figure 8)

This borehole was located adjacent to the northern side of Baltmoor Wall between Athelney Hill and East Lyng, and contained 0.44 m of detrital peat intercalated with alluvial silts. A total of seven sub-samples was examined to assessment level. Radiocarbon dates of 2130–1740 Cal BC (AA33143) for the top of the peat and 2140–1910 Cal BC (WK16764) for the bottom of the peat have been obtained (Table 2). This places the sequence within the early Bronze Age.

Pollen analysis of the peat was undertaken as this had the best potential for pollen preservation. Two local pollen assemblage zones have been recognised in the profile, which relate to environmental and resultant taphonomic changes. The principal characteristics of the sequence are given in Table 4.

The vegetation

The change in stratigraphy from peat to mineral sediment between the two pollen zones clearly represents a significant shift from an anaerobic, peat-forming environment to one of lacustrine or alluvial conditions. The pollen data demonstrate that the on-site (or in close proximity) vegetation was dominated by alder (*Alnus glutinosa*), probably being fen carr woodland (Alnetum), which accounts for the detrital character of the peat and small numbers of wet fen taxa. Willow (*Salix*), as previously noted, is largely under-

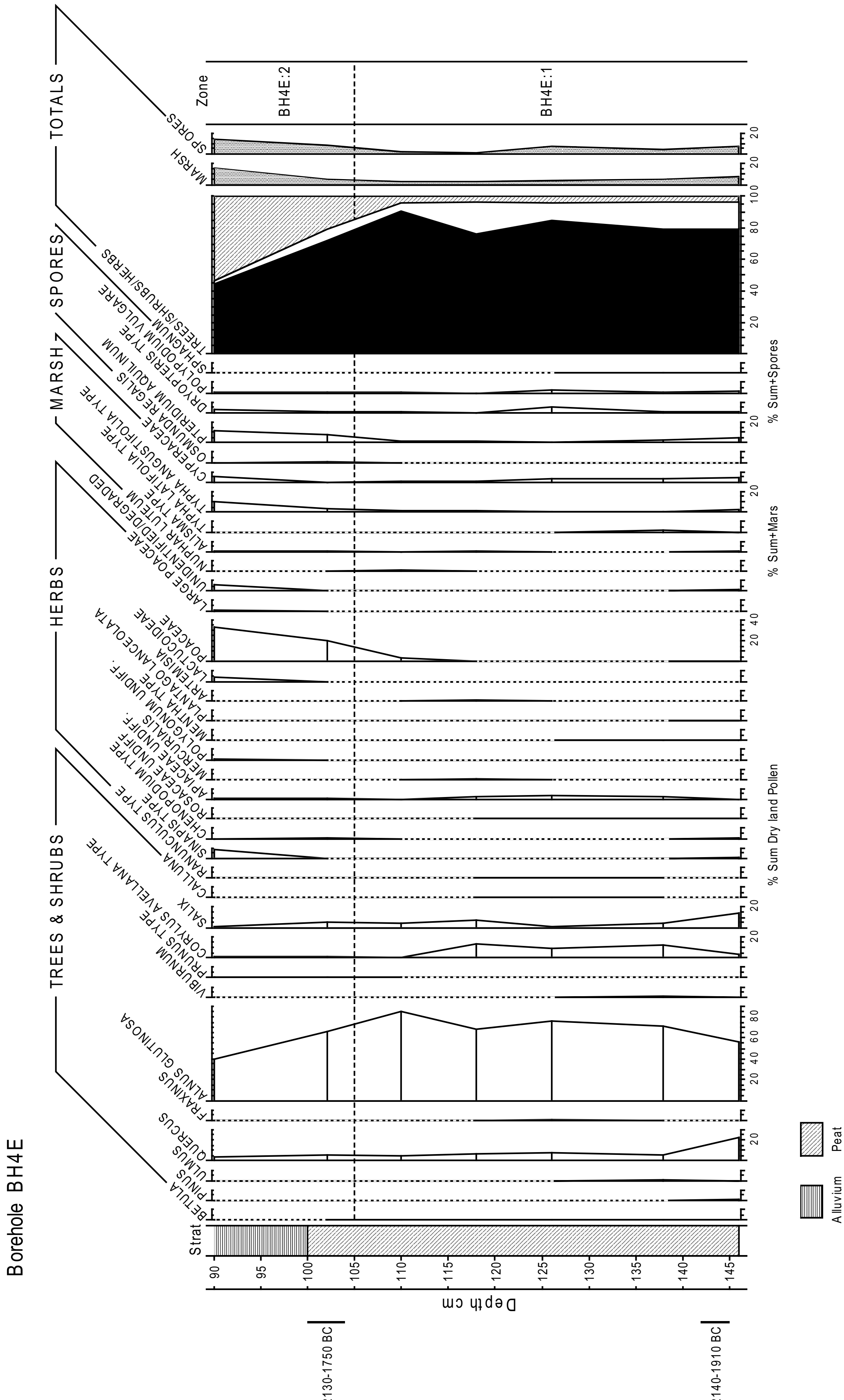
Borehole BH4E
TREES & SHRUBS
HERBS
MARSH
SPORES
TOTALS
BETULA
PINUS
ULMUS
QUERCUS
FRAXINUS
ALNUS GLUTINOSA
VIBURNUM
PRUNUS TYPE
CORYLUS AVELLANA TYPE
SALIX
CALLUNA
RANUNCULUS TYPE
SINAPIS TYPE
CHENOPODIUM TYPE
ROSACEAE UNDIFF.
APIACEAE UNDIFF.
MERCURIALIS
POLYGONUM UNDIFF.
MENTHA TYPE
PLANTAGO LANCEOLATA
ARTEMISIA
LACTUCOIDEAE
POACEAE
LARGE POACEAE
UNIDENTIFIED/DEGRADED
NUPHAR LUTEUM
ALISMA TYPE
TYPHA LATIFOLIA TYPE
TYPHA ANGUSTIFOLIA TYPE
CYPERACEAE
OSMUNDA REGALIS
PTERIDIUM AQUILINUM
DRYOPTERIS TYPE
POLYPODIUM VULGARE
SPHAGNUM
TREES/SHRUBS/HERBS
MARSH
SPORES
Zone
BH4E:2
BH4E:1
Strat
Depth cm
% Sum Dry land Pollen
% Sum+Mars
% Sum+Spores
Alluvium
Peat
2130-1750 BC
2140-1910 BC

Table 4. BH4E, pollen assemblage zones.

Zone BH4E: 2 Change from peat to alluvial silt 105 cm to 90 cm *Alnus*-Poaceae	*Alnus* and *Corylus avellana* type values are reduced whilst herbs, especially Poaceae increase to high values. Poaceae is the dominant taxon with *Sinapis* type and Lactucoideae. Marsh taxa become more important and include *Typha angustifolia* type, Cyperaceae and spores *Osmunda regalis*. Radiocarbon dated at 2130–1750 Cal BC at base of pollen zone/top of peat.
Zone BH4E: 1 Fen peat146 cm to 105 cm *Alnus-Corylus avellana* type-*Salix*	*Alnus* is dominant with *Corylus avellana* type and *Salix*. *Quercus* has highest values in the base but declines throughout the zone. There are few dry land herbs with only fen taxa of any importance, especially *Typha latifolia, Typha angustifolia* type and Cyperaceae. Radiocarbon dated to 2140–1910 Cal BC at the base of the zone.

Table 5. Section 1A, pollen assemblage.

Section 1A Peat and with humic silt 92 cm to 128 cm	*Alnus* is dominant. *Quercus*, *Salix* and *Corylus avellana* type are also important, the latter declining from importance at the base to absence at the top of the profile. There is a diverse range of herbs with Poaceae being of greatest importance. There are also small numbers of *Plantago lanceolata*, Apiaceae, and Asteraceae types. Marsh and aquatic taxa comprise *Typha angustifolia* type, with occasional *Hydrocotyle, Alisma, Nuphar* and *Typha latifolia. Pteridium* aquilinum is the principal fern with highest vales at the base of the profile. There are small numbers of monolete Pteropsida (*Dryopteris* type)

represented in pollen spectra and the values present here demonstrate that it was also an important constituent of this alder vegetation community. With the onset of alluvial conditions, alder and willow become less important, as conditions became too wet for their growth. Thus, change to alluvial sediments is mirrored by a change to grass/sedge/reed fen. The dominance of alder carr will have effectively restricted the pollen catchment and some taxa that are prone to under-representation, such as lime (*Tilia*) and ash (*Fraxinus excelsior*), will be poorly represented. This may be the case here. Oak (*Quercus*) and hazel (*Corylus avellana*) with occasional elm (*Ulmus*) pollen are also present.

Section 1A (Figure 9)

Like borehole **BH4E**, this section was located on the northern side of Baltmoor Wall between Athelney Hill and East Lyng, and contained 45 cm of peat overlain by alluvial sediments and underlain by a red silty clay. A total of six sub-samples from the peat and overlying sediment was examined to assessment level. Because of the proximity of the location of this sample to BH4E it is assumed that the sequence also dates to the Early Bronze Age. Comparison of the pollen spectra would indicate that this is the case, although the pollen spectra is more homogeneous and lacks the marked changes associated with the succession to mineral sediments. Only small changes are apparent in this profile and no pollen assemblage zones have been recognised. Table 5 consequently describes only the principal characteristics of the sequence.

Figure 8 (left). Percentage pollen diagram from Borehole BH4E.

The vegetation

Alder (*Alnus glutinosa*) and willow (*Salix*) are dominant on and near the site, although there is also substantial evidence of reed swamp/open herb fen taxa, with sedges (Cyperaceae) and reed mace/bur reed (*Typha angustifolia* type). The surrounding dry land vegetation is oak (*Quercus*) and hazel (*Corylus avellana* type) dominated, although it is important to note that small numbers of lime/linden (*Tilia*) exist. Lime pollen is poorly represented in pollen spectra (Andersen 1970, 1973) and its presence here suggests some local growth on better drained soils. Also of note are the slightly greater numbers of herbs, which include grasses (Poaceae), ribwort plantain (*Plantago lanceolata*) and occasional cereal pollen. It is possible that these pollen taxa come from dry land closer to the sample site than the evidence of borehole BH4E.

Section TT1 (Figures 10 and 11)

This trial trench was located adjacent to Athelney Hill and to Baltmoor Wall on its northern side. A 32 cm-thick peat deposit was exposed, with silty peat overlying and silty clay below. The peat is radiocarbon dated (Table 2) at its bottom to the early Bronze Age, 2140–1890 Cal BC

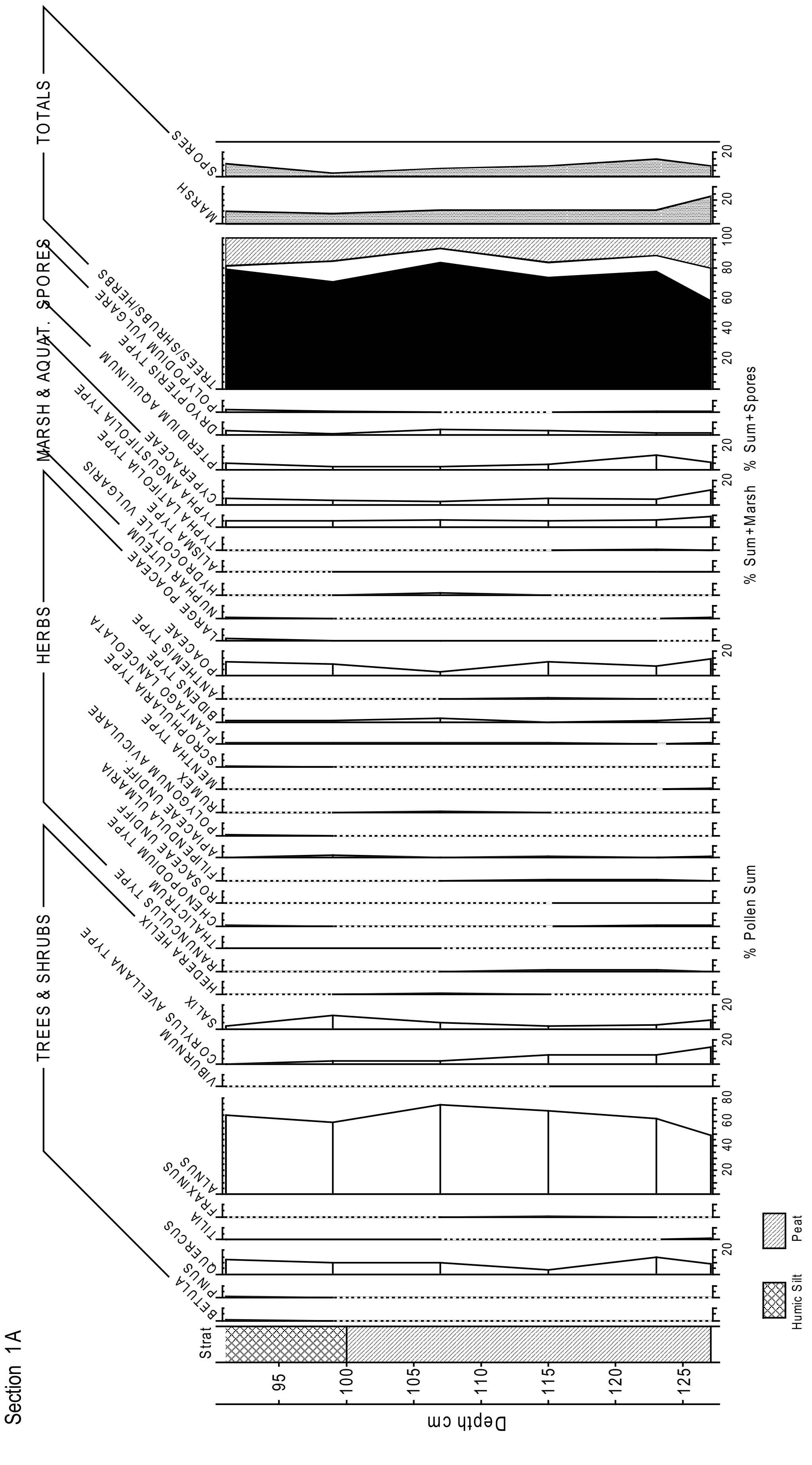
Section 1 A
TREES & SHRUBS
HERBS
MARSH & AQUAT.
SPORES
TOTALS
BETULA
PINUS
QUERCUS
TILIA
FRAXINUS
ALNUS
VIBURNUM
CORYLUS AVELLANA TYPE
SALIX
HEDERA HELIX
RANUNCULUS TYPE
THALICTRUM
CHENOPODIUM TYPE
ROSACEAE UNDIFF.
FILIPENDULA ULMARIA
APIACEAE UNDIFF.
POLYGONUM AVICULARE
RUMEX
MENTHA TYPE
SCROPHULARIA TYPE
PLANTAGO LANCEOLATA
BIDENS TYPE
ANTHEMIS TYPE
POACEAE
LARGE POACEAE
NUPHAR LUTEUM
HYDROCOTYLE VULGARIS
ALISMA TYPE
TYPHA LATIFOLIA TYPE
TYPHA ANGUSTIFOLIA TYPE
CYPERACEAE
PTERIDIUM AQUILINUM
DRYOPTERIS TYPE
POLYPODIUM VULGARE
TREES/SHRUBS/HERBS
MARSH
SPORES
Strat
Depth cm
95
100
105
110
115
120
125
20
40
60
80
100
% Pollen Sum
% Sum+Marsh
% Sum+Spores
Humic Silt
Peat

Figure 9 (left). Percentage pollen diagram from Section 1A.

(WK16612) and at its top to the middle to late Bronze Age, 1370–920 Cal BC (AA33142). A total of 13 sub-samples were examined to full analysis level from throughout the monolith sample. Four local pollen assemblage zones were recognised. The principal characteristics of the sequence appear in Table 6.

The vegetation of the mire

Throughout this profile, pollen values of alder (*Alnus glutinosa*) are high. Although this tree may be over-represented in pollen spectra (Andersen 1970; 1973), as it is anemophilous and produces substantial quantities of pollen, the values here are high enough to suggest it was growing on or at least very near to the site. This would have formed floodplain carr woodland (*Alnetum*) and growth along the fringes of a mire.

Although alder is the locally dominant wetland taxon, there are significant changes in the status of the marsh/fen. In Zone TT1.1, alluvial silts were laid down in a grass/sedge fen/reed swamp, with areas of alder and willow. This habitat then became drier and a peat-forming community became established under alder and willow, with a restricted ground flora of grasses and sedges (Zone TT1.2). Buckthorn (*Rhamnus cathartica*) and wayfaring tree (*Viburnum lantana*) recorded in this pollen zone may also be elements of this floodplain woodland. Subsequently, local water tables became higher causing ponding back of freshwater fluvial systems. This resulted in the development of the freshwater communities of Zone TT1.3, with yellow and white water lily (*Nuphar* and *Nymphaea*) and the recurrence of reed swamp taxa including reed mace/bur reed (*Typha angustifolia* type). Willow (*Salix*) also became locally dominant. Willow is generally poorly represented in pollen spectra and the values recorded here suggest growth actually on site. With further water logging, willow was unable to survive and in Zone TT1.4 there was a change to a wetter grass/sedge fen. Aquatic macrophytes include higher values of pond weed (*Potamogeton* type), indicating areas of standing open water.

The vegetation of the interfluves

The vegetation of the adjacent dry land, including the island of Athelney, supported mixed woodland throughout the profile. At first view, the high pollen values of oak (*Quercus*) and hazel (*Corylus avellana*) suggest that these were the dominant woodland elements. However, while this may have been the case, there are small but consistent values throughout of lime/linden (*Tilia cordata*), ash (*Fraxinus excelsior*) and occasional holly (*Ilex aquifolium*). These taxa are markedly under-represented in pollen spectra/assemblages, especially in comparison to the oak and hazel, which are wind pollinated and thus produce copious quantities of pollen. Furthermore, the habitat of the site was one of dense alder carr, and this may have had a filtering effect on the ingress

Table 6. Section TT1, pollen assemblage zones.

Zone TT1: 4 Silty peat 152 cm to 146 cm Poaceae-Cyperaceae	There is a reduction in tree (*Quercus*) and shrub (*Corylus avellana* type) pollen and a marked expansion of herbs. The latter comprise Poaceae, cerealia, Asteraceae types and Apiaceae. *Alnus* remains the dominant fen taxon with a decline of *Salix*. There is a diverse range of fen-marsh and aquatic taxa; *Nymphaea, Nuphar*, *Myriophyllum*, *Sagittaria, Iris* and *Potamogeton* type.
Zone TT1: 3 Peat and transition to silty peat from 154cm 172 cm to 152 cm *Quercus-Corylus avellana* type-*Alnus-Salix*	The upper peat with highest absolute pollen frequencies (to 190,000 grains/ml). This zone is delimited by a sharp increase in *Salix*. *Quercus*, and *Corylus avellana* type remain the dominant tree/shrub. *Fraxinus* shows some expansion. Herb pollen starts to become more important with Poaceae, cerealia, *Plantago lanceolata* and other type. Fen taxa remain dominated by *Alnus* but with the increase of *Salix*. Aquatics are present with *Nymphaea, Nuphar, Lemna* and *Potamogeton* type. Radiocarbon dated at 1370–920 cal. BC at top of the peat.
Zone TT1: 2 Peat 184 cm to 172 cm *Quercus-Corylus avellana* type	This zone is characterised by an expansion of *Corylus avellana* type to high values with a slight reduction of *Quercus*. Herbs are at their lowest values. Fen taxa are dominated by *Alnus* with high values and *Salix*. Fen herb taxa include small numbers of *Typha angustifolia, Alisma* and Cyperaceae. *Polypodium* attains its highest values.
Zone TT1: 1 Humic silt and transition to peat 196 cm to 172 cm *Quercus-Corylus avellana* type-*Alnus*-Poaceae	This zone is characterised by the importance of trees and shrubs. *Quercus* and *Corylus avellana* type are dominant with small numbers of *Tilia* and *Fraxinus*. Herbs comprise largely Poaceae with small numbers of cerealia and *Plantago lanceolata* and Chenopodiaceae. Marsh/fen taxa are dominated by *Alnus* and *Salix* with small numbers of *Typha angustifolia* type, *T. latifolia* and Cyperaceae. Spores of Pteridophytes comprise *Pteridium, Dryopteris* type and *Polypodium.*

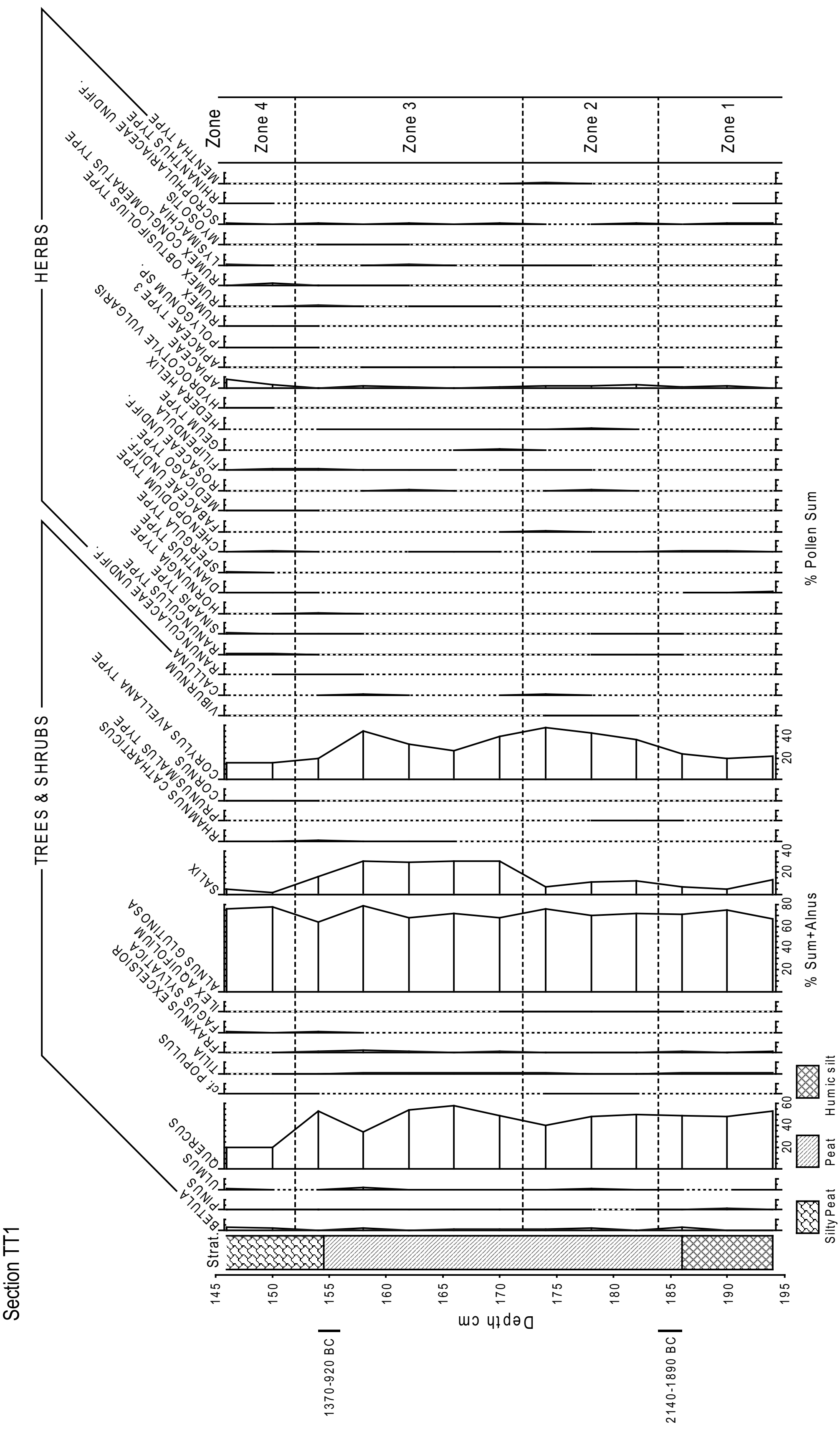

Figure 10. Percentage pollen diagram from Section TT1 (1 of 2).

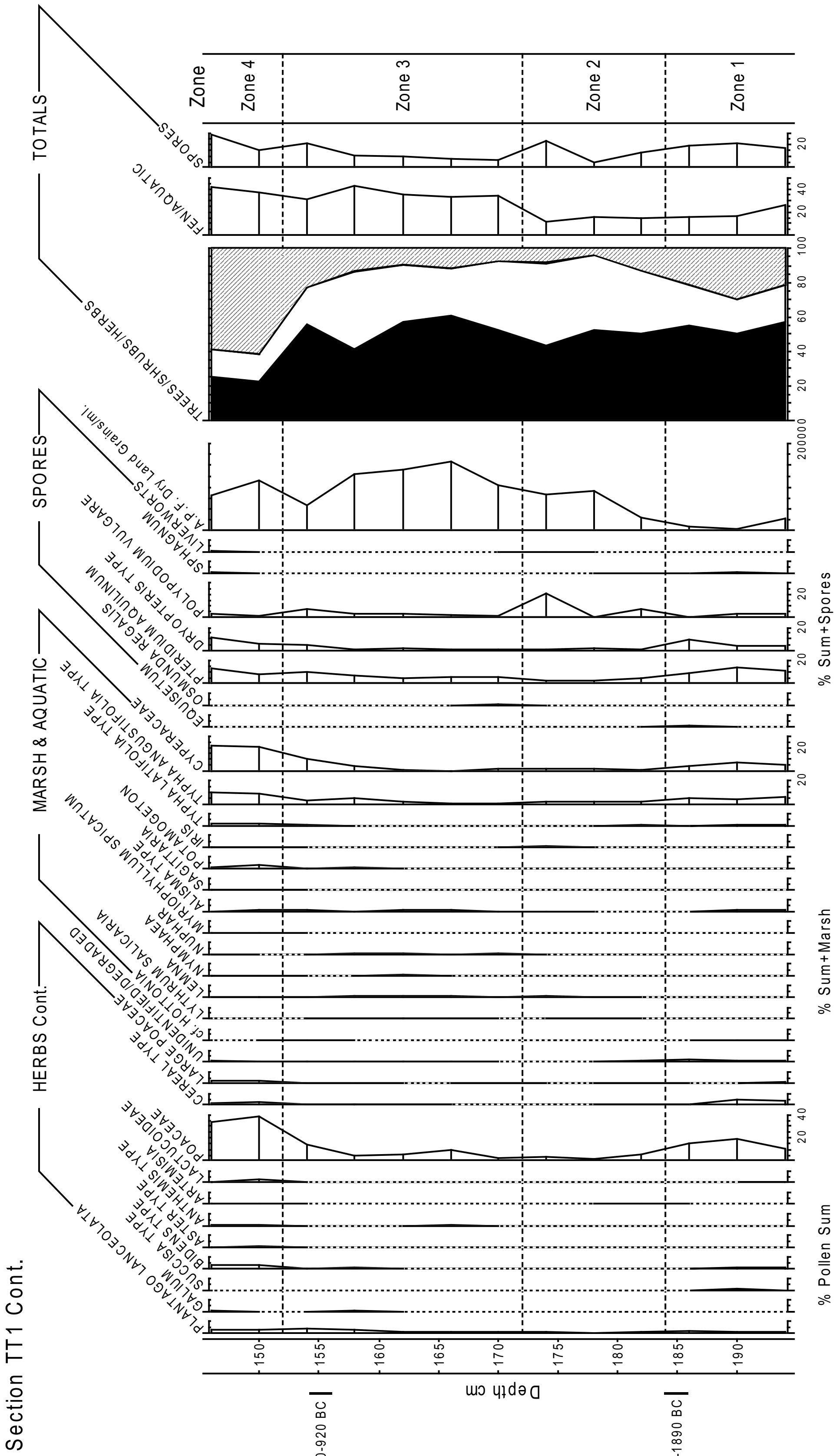

Figure 11. Percentage pollen diagram from Section TT1 (2 of 2).

of pollen from areas outside of this community (see above). Thus, it is most probable that the interfluves supported woodland with important quantities of these trees. It is also possible that oak and hazel formed woodland on thicker soils fringing the mire, and as elements on dry areas the mire itself.

The vegetation of the wider landscape

The filtering effect is to some extent seen in the range of herb pollen taxa present in Zone TT1.2 and, to a lesser extent, Zone TT1.3. However, where conditions were wetter with alluvial influences (rather than anaerobic, peat-forming conditions), the pollen taphonomy changes from almost solely airborne derivation to a mixture of airborne and fluvial transport. The water-borne may well have travelled further than the very localised pollen of the purely peat-forming habitat, and therefore provides information on the vegetation landscape over a much wider (upstream) zone. Here, there are clear indications that arable cultivation was taking place, both before the start of the peat accumulation, at the end of Zone TT1.1 (WK16764; 2140–1890 Cal BC) and after it, at the end of Zone TT1.4 (WK 10685; 1370–920 Cal BC). Occasional cereal pollen grains also occur in the peat of Zone TT1.2 and Zone TT1.3, suggesting continued cultivation throughout the period. This also applies to non-cultivated grasses and other grassland-associated taxa such as ribwort plantain (*Plantago lanceolata*), which indicate pastoral agriculture. It is not possible to know where cultivation was taking place within the fluvial catchment, possibly in fields on the adjacent dry land, which also remained partially wooded, or farther afield.

Summary of Section TT1

The pollen data from Section TT1 show a Bronze Age environment dominated locally by woodland. This consisted of lime, ash, oak and hazel as mixed woodland on drier soils or, alternatively, drier woodland areas of ash and lime with the heavier soils of the lower slopes more suited to oak and hazel. The depositional environment was one of wetland carr woodland. Initially this was alder-dominated on site, but due to increasing wetness became one of willow carr (but with alder remaining important). Such dominant woodland will have restricted the pollen catchment to the very local area during the period when only peat was forming. The upper and lower levels of the profile have evidence of greater wetness and fluvial activity, and/or the development of fen, the latter also apparent from the plant macrofossils (below). There is some evidence of Bronze Age agricultural activity with cereal cultivation and possibly pastoral activity, which is seen more clearly in the sediments associated with increased wetness and alluviation.

Section S1 (Figure 12)

This section was located across Baltmoor Wall adjacent to Athelney Hill. Sampled deposits comprised a 0.1 m-thick peat deposit intercalated with mineral sediments from below Baltmoor Wall. The peat has been radiocarbon dated (Table 2) to the late Roman period, 230–440 Cal AD (WK16611). A total of four sub-samples were examined from the monolith sample to assessment level: two from the peat, and two from the underlying mineral sediment.

Although only a small number of levels were examined, two pollen assemblage zones have been recognised, which correspond with the changing stratigraphy from the lower mineral sediments to overlying peat. Thus, the change in pollen taphonomy are due to a substantial local environmental change. The principal characteristics of the sequence are described in Table 7.

The vegetation

While oak (*Quercus*), hazel (*Corylus avellana* type), alder (*Alnus glutinosa*) and willow (*Salix*) are present, herbs are more important with dominance of grasses (Poaceae) and sedges (Cyperaceae), the latter especially with change to peat from freshwater alluvium. This represents a shift to a wet grass-sedge fen at this site. There is some evidence of terrestrial pasture with ribwort plantain (*Plantago lanceolata*). No evidence of arable practices was found. However, this study was only carried out to assessment level with fewer than normal pollen sums/counts obtained (to 200 grains per sample).

Figure 12 (right). Percentage pollen diagram from Section S1.

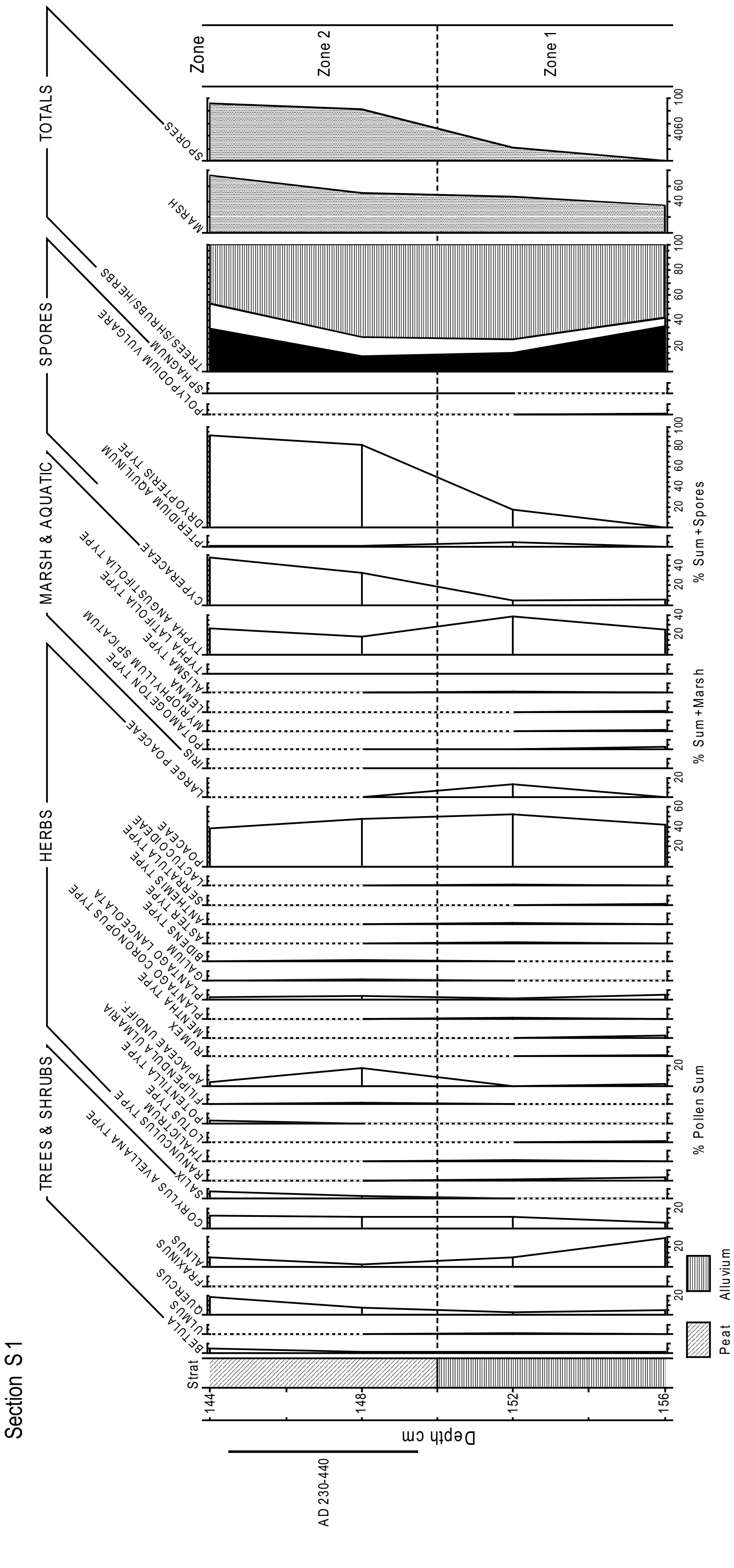
Section S1
TREES & SHRUBS
HERBS
MARSH & AQUATIC
SPORES
TOTALS
Zone
Zone 2
Zone 1
Strat
Depth cm
AD 230-440
% Pollen Sum
% Sum+Marsh
% Sum+Spores
Peat
Alluvium

Table 7. Section S1, pollen assemblage zones.

Zone 1A: 2 Peat 150 cm to 144 cm Poaceae-*Typha angustifolia* type-Cyperaceae-*Dryopteris* type	This zone features a marked expansion of Cyperaceae and Pteridophyte spores. Trees comprise *Quercus* which expands to the top of the profile. There are small numbers of *Alnus* and *Salix*. Herbs are dominated by Poaceae with a single peak of Apiaceae and small numbers of *Plantago lanceolata*. There is a marked change in the marsh/aquatic taxa with an expansion of Cyperaceae decline of *Typha angustifolia* type and a reduction in the diversity of aquatic macrophytes with change to peat sediments. There is a significant expansion of spores which are probably of marsh fern. Radiocarbon dated to Cal AD 230–440.
Zone 1A: 1 Alluvial silt 156 cm to 150 cm Poaceae-*Typha angustifolia* type	Herbs are most important with a moderately diverse range of taxa of which Poaceae is most important. Marsh taxa are dominated by *Typha angustifolia* type which attains high values with small numbers of *Potamogeton* type, *Myriophyllum* and *Lemna*. Trees comprise largely *Alnus* with highest values at the base of the zone with some *Quercus* and *Corylus avellana* type.

Borehole BH1D (Figures 13 and 14)

This borehole was located to the south of Athelney Hill at Athelney Farm, and comprised a 26 cm-thick deposit of peat overlying humic silt deposits, itself overlain by a silt/peat transition deposit under further silts. The bottom of the main peat has been radiocarbon dated (Table 2) to the Roman period, 70–260 Cal AD (WK16763), and the top of the peat, at 2.43 m (3.57 m AOD) to the medieval period, 1020–1230 Cal AD (AA33139). These dates are taken from the base and top of the main peat deposit. The sediments examined from above and below the peat extend the time period identified. It should be noted that the mineral sediments may have accumulated rapidly.

Pollen analysis was carried out on the deposits lying between 2.92 m and 1.88 m, which encompasses the basal freshwater sediments, the transition into fen peat and a subsequent phase of alluviation. A total of 22 samples were examined to full analysis level, which produced a very diverse range of pollen taxa (94 in total). As might be expected, absolute pollen frequencies are relatively high in the basal freshwater sediment an overlying fen peat, with values of >250,000 grains/ml. These decline into what are thought to be floodplain alluvial sediments to values of <10,000 grains/ml. Pollen preservation was poorer in this upper minerogenic material, as is characteristic of alluvial sediments (Burrin and Scaife 1984; Scaife and Burrin 1992).

Overall, the pollen assemblages have a dominance of herbs with relatively few trees and shrubs. As might be expected there is a strong representation of aquatic and fen taxa. Spores of ferns are also well represented. A total of five pollen zones have been recognised in this profile. These are dictated by both the changing vegetation and the changing taphonomy of the sediment type and its derivation. The principal characteristics of the sequence are described in Table 8.

The vegetation of the mire

As with TT1 (above), the pollen spectra/assemblages provide a record of the autochthonous and allochthonous vegetation. Again, the changes in the broader environment have substantially influenced the taphonomy of the pollen especially in relation to pollen catchment area.

The peat lies between mineral sediments of obvious earlier and later age. Below the peat is a highly humic silt which is rich in diatoms (see below) and pollen. Pollen Zone BH1D.1 corresponds with this distinct lithostratigraphical unit. The pollen data demonstrate that these sediments accreted in a grass/sedge/reed fen with areas of standing water, with aquatic macrophytes such as duckweed (*Lemna*), water milfoil (*Myriophyllum*) and pond weed (*Potamogeton* type), and shallow-water rooting marginal plants including water plantain (*Alisma plantago aquatica*), arrowhead (*Sagittaria sagittifolia*), iris and particularly reed mace/bur reed (*Typha angustifolia* type) and sedges (Cyperaceae). There are also occasional cysts of algal *Pediastrum*. Alder (*Alnus glutinosa*) pollen is also present but, however, values are small. Given that this tree is a very substantial producer of pollen, if present in places along the fringes of the mire and local rivers, the numbers of trees would have been small. This environment differs markedly from the dense alder and willow carr fen woodland observed in the late prehistoric profile of TT1 (above). There are also very substantial

Table 8. BH1D, pollen assemblage zones.

Zone BH1D: 5 Upper alluvial sediments 212 cm to 188 cm Poaceae-Lactucoideae-Pre-Quaternary	The overall pollen characteristics are as in the preceding zone but with dominance of Poaceae but with a substantial expansion of Lactucoideae. Cerealia remain present. There are also increases in spores of *Polypodium vulgare* and reworked geological palynomorphs. Dinoflaggellates are also present. Trees and shrubs comprise small numbers of *Quercus* and *Corylus avellana* type with occasional *Fraxinus*. Absolute pollen numbers are at their lowest in this zone.
Zone BH1D: 4 Alluvial sediments 238 cm to 212 cm Poaceae-Lactucoideae-Cerealia- *Typha angustifolia* type	The high levels of *Salix* and Cyperaceae in the preceding zone return to low levels and absence. Quercus and Corylus avellana type remain the principal trees/shrubs. Herb diversity is also low. Poaceae are dominant attaining high values with Lactucoideae and cerealia also important. There is also an expansion of Chenopodiaceae with peaks at 236 cm and 228 cm. *Typha angustifolia* type remains important whilst Cyperaceae decline. Pre-Quaternary palynomorphs start to appear in the sequence.
Zone BH1D: 3 Transition from peat to alluvial sediments 258 cm to 238 cm *Quercus-Corylus avellana* type- *Salix-Alnus-Cyperaceae*	This zone is characterised by expansions of *Alnus* and *Salix* and reductions of fen herb taxa and fern spores. Absolute pollen frequencies decline in this and the above zones. *Quercus* and *Corylus* are the principal tree taxa with small numbers of *Betula*. *Alnus* becomes more important. Herbs remain dominated by Poaceae which attains its highest values. Other herbs also become more important from this zone including Lactucoideae and cerealia. Radiocarbon dated to Cal AD 1020–1230 at the top of the zone.
Zone BH1D: 2 Base of the peat 278 cm to 258 cm *Quercus-Corylus avellana* type-Poaceae- *Typha angustifolia* type-*Dryopteris* type	Herbs are dominant with increasing values of tree and shrub pollen and monolete fern spores (*Dryopteris type*) increasing. Trees and shrubs include *Betula, Quercus* and *Corylus avellana* type. Herbs comprise Poaceae at levels of preceding zone 1 but with reductions in cerealia and Apiaceae. Marsh and aquatic taxa remain important with *Typha angustifolia* and Cyperaceae dominant. There is a marked peak of Pteropsida (*Dryopteris* type) spores. Radiocarbon dated to Cal AD 70–260 at the base of the zone.
Zone BH1D: 1 Basal freshwater sediments 294 cm to 278 cm Poaceae-Apiaceae-Plantago lanceolata- *Typha angustifolia* type-Cyperaceae	Herbs are dominant with Poaceae most important with Apiaceae and *Plantago lanceolata.* Cerealia are present from the base of the profile. There is a diverse assemblage of marsh and aquatic taxa with *Alnus*, Cyperaceae and *Typha angustifolia* type. Trees are dominated by *Alnus, Quercus, Corylus avellana* type and occasional *Betula, Fagus*, and *Populus*. Absolute pollen numbers are at their maximum in this sequence (*c*. 200, 000 grains/ml).

numbers of umbellifers (Apiaceae), suggesting this was also a constituent of the fen.

After the aquatic/wet fen phase of Zone BH1D.1, there appears to have been a typical hydrosere with progressive development of a drier fen in Zone BH1D.2, in which conditions (anaerobic) became suited to peat formation. This is a compacted detrital fen peat of two broad phases. Initially, reed swamp/fen remained important with fewer areas of standing water (hence the reduction in aquatic macrophytes) but reed mace/bur reed and sedges remained dominant with other marginal fen taxa. Increasing values of willow (*Salix*) suggest that this was starting to colonise from the drier fringes of the wetland. Substantial numbers of fern spores (not identifiable to a lower taxonomic level) were probably from marsh fern taxa. Similarly, the umbellifers are possibly from marsh taxa (eg *Oenanthe* spp.).

Subsequently, the mire continued to become a drier community (as part of the hydrosere) in Zone BH1D.3, culminating in development of willow (and a little more alder) on or near the site, but with a remaining strong herb fen flora of grasses, sedges and some reed-mace/bur reed. At *c* 1020–1250 Cal AD (AA33139), there was a change, perhaps within the broader region, which saw a change from peat-forming conditions to one of floodplain alluviation. This change is apparent in the upper part of BH1D.3 as a transition from pure peat through humic sediments to less humic silts representing this later stage of alluviation. By Zone BH1D.4, there was a cessation of peat formation and a reduction in the associated flora, with willow and alder declining to low levels. Other fen herb taxa remained but with increasingly reduced values, although reed-mace/bur reed remained important. The pollen taphonomy will also have changed at this time, and some pollen was clearly fluvially transported, with the diagnostic indications of geologically derived pollen and spores, eroded from bedrock and earlier sediments. Typical also, are the higher values of fern spores (monolete *Dryopteris* forms, *Polypodium vulgare* and *Pteridium aquilinum*). These are robust microfossils which may be over-represented in sediments lain down at time of high fluvial discharge (Peck 1973; Burrin and Scaife 1984; Scaife and Burrin 1992).

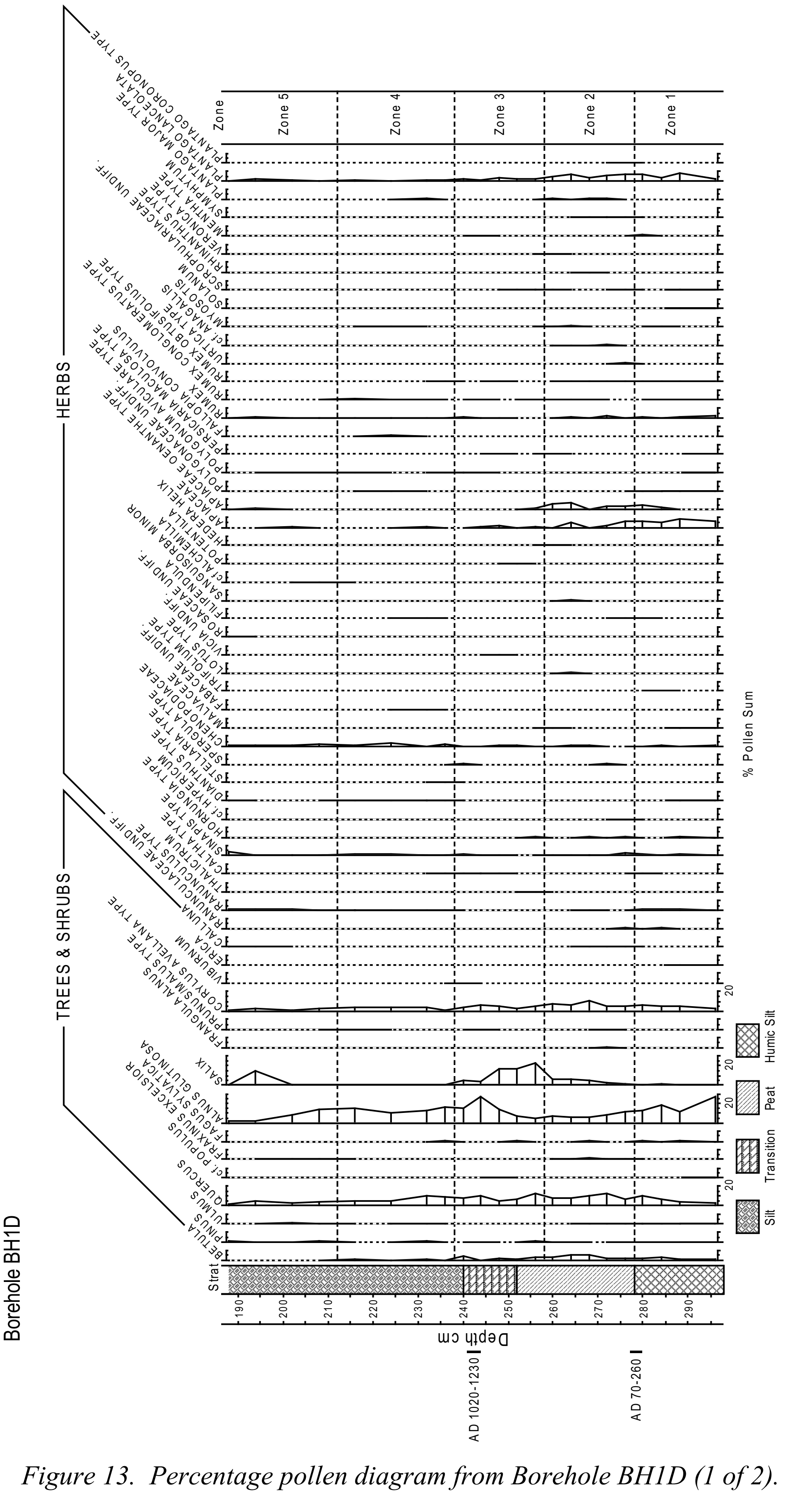

Figure 13. Percentage pollen diagram from Borehole BH1D (1 of 2).

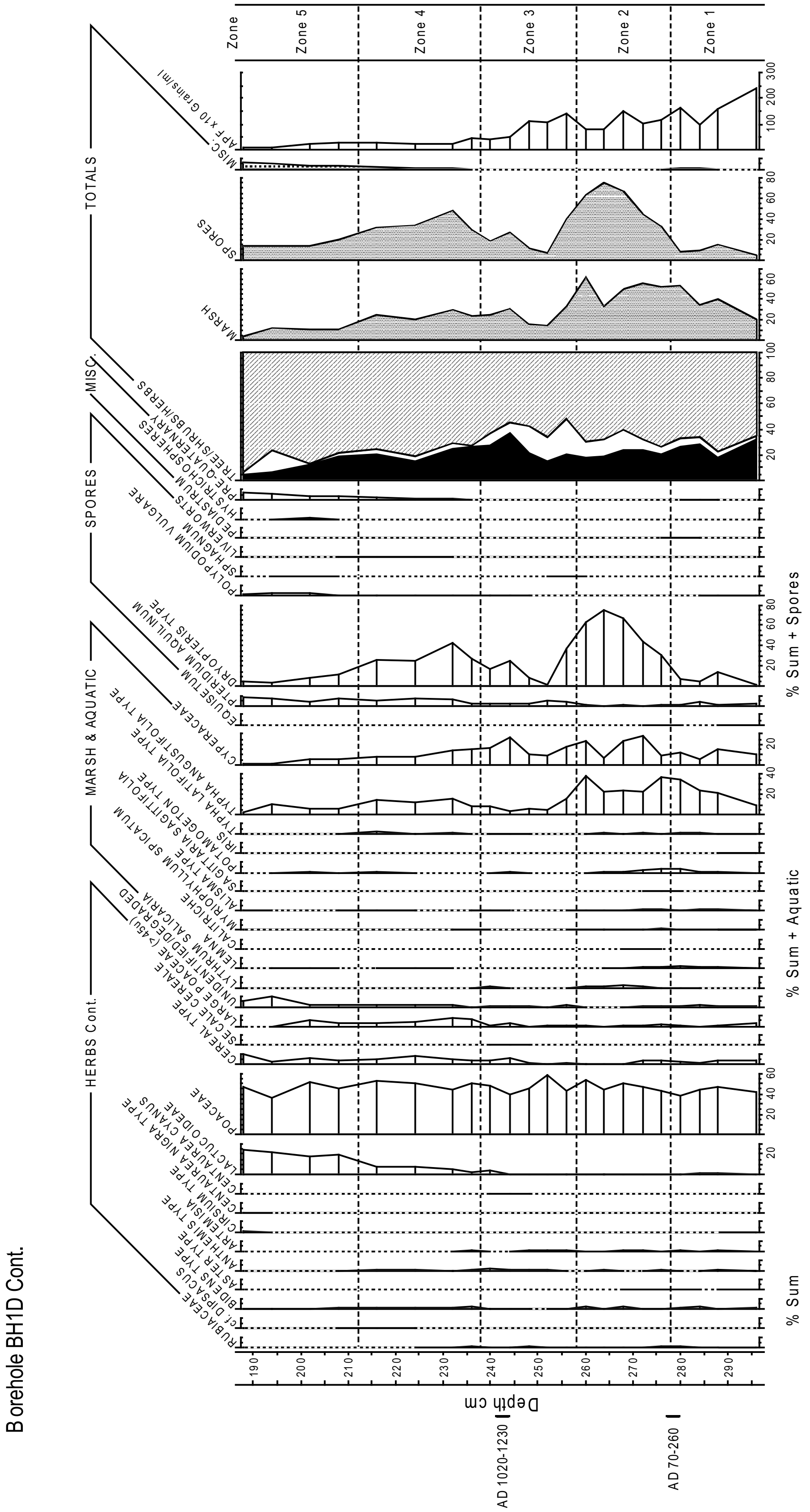

Figure14. Percentage pollen diagram from Borehole BH1D (2 of 2).

The upper alluvial sediments in Zone BH1D.5 are interesting (along with upper sediment in BH4E; see below) as there is some evidence for the ingress of marine or brackish water containing diagnostic diatoms (see *diatom analysis* below). A corresponding increase in Chenopodiaceae (goosefoots, oraches and glassworts) pollen may derive from salt marsh communities. Dinoflagellates (Hystrichospheres) have also been noted at 200 cm; these may have been derived from reworked geological sediments, although the strong diatom evidence suggests that there were periodic incursions, probably at highest tides or as storm surges. Such events are likely to have transported material from distant salt marsh (halophytic) communities and especially Chenopodiaceae, which in many cases produce substantial quantities of pollen. Subsequently, the region has been subjected to further drainage and creation of wet pasture.

The vegetation of the interfluves

Overall, the pollen data demonstrate a largely open environment from the onset of alluviation through the environmental changes noted in the mire vegetation (above). The consistent values of oak and hazel are typical of many pollen spectra for the historic period from southern Britain. This clearly remained the most important woodland over the region. Birch is also present in the lower zones of this sequence. This is a copious producer of (wind-pollinated) pollen and as such it was probably of little significance locally. This also applies to pine, which has even smaller values coming from long distance transport from extra-regional sources. In contrast, the sporadic occurrences of ash and especially beech may attest to some occasional local growth of these usually under-represented pollen taxa.

In term of human activity, there is evidence of both arable and probably pastoral agriculture, although the latter is not as easy to differentiate in pollen spectra since grasses themselves are catholic and pollen may originate from many types of plant communities. However, ribwort plantain (*Plantago lanceolata*) and other herbs may provide a clearer indication. *Plantago* is relatively important in Zones BH1D.1–3 along with occasional peaks of buttercups (*Ranunculus* spp.), docks (*Rumex* spp.), figworts (Scrophulariaceae) and daisies (Asteraceae types), all of which are suggestive of local pastoral agriculture. In Zone BH1D.4 (the upper alluvial sediments) there is a substantial increase of Lactucoideae (dandelion types). These are usually regarded as evidence of pastoral, grassland communities, although there are also many arable-associated taxa within this group. It is also a strong indicator of differential preservation in less favourable conditions, as it remains in sediments because of its robust exine. Both factors are relevant here, with its expansion in the upper zones due to it probably being both derived from local floodplain pasture and over-represented in the poorer preserving conditions of the upper alluvial sediments.

Cereal cultivation is more easily identified from pollen spectra than pastoralism, although pollen frequencies of cereals and associated segetal taxa are frequently small. Cereal pollen is present, especially in the basal freshwater sediments and in the lower peat, but dies out when the habitat became a more enclosed willow carr woodland. This implies local cereal cultivation and thus mixed agricultural practices. Identification of the cereal pollen here to other than wheat or barley is not easily possible, but there are occasional records of rye (*Secale cereale*), which is diagnostic. Weeds of waste ground and agriculture may include blue corn flower (*Centaurea cyanus*), greater plantain (*Plantago major*), brassicas (*Sinapis* type), spurrey (*Spergula*), mallows (Malvaceae), goosefoots and oraches (Chenopodiaceae), knotgrasses and persicarias (*Polygonum* sp. and *Persicaria* sp.), and mugworts, mayweeds and chamomiles (all Asteraceae types). Many of these pollen types are not identifiable to a lower taxonomic level and thus are not definitively from arable habitats, however, there is sufficient evidence, however, to suggest that arable cropping of rye and wheat/barley was being practiced in the local area.

Summary of BH1D

The peat deposit comprises a highly compacted, slow forming detrital peat. Earlier humic silts formed in a freshwater fen and aquatic environment. Sediments overlying the peat differ somewhat, being of floodplain, alluvial origin from overbank deposition during winter months and periods of high discharge, and may have formed rapidly. The sedimentary sequence thus displays a hydroseral succession developing from areas of open water to a reed swamp, which became drier allowing colonisation by willow. This was followed a retrogressional hydrosere, with flooding and alluviation causing local removal of the willow carr and other herbaceous elements of the fen. The profile also shows evidence for oak and hazel woodland in the region, which is likely to have been managed. Otherwise, the environment of drier ground and better drained soils supported both pastoral and arable agriculture, with strong evidence for cereal cultivation.

PLANT MACROFOSSIL ANALYSIS

David Robinson

Samples for macrofossil analysis were examined from the two principal profiles TT1 and BH1D. Information gained was expected to provide an insight into the depositional and vegetational habitat of the site.

Plant macrofossil method

Four sub-samples of 100 ml were removed from the monolith sample from section TT1. Two sub-samples from BH1D comprised the combined remains of sub-samples taken for assessment and analysis of pollen, diatom and foraminifera. All samples were soaked in tap water overnight then gently washed through two sieves with mesh apertures of 1 mm and 0.35 mm respectively. The whole of the 1 mm fraction and from 25% to 50% of the 0.35 mm fraction were then examined under a low-power stereo microscope at a magnification of x6.3. All potentially identifiable material was picked out and identification took place use the same microscope at magnifications of x6.3 to x50, and by reference to relevant literature and a collection of recent plant remains. Plant nomenclature follows Stace (1991).

Section TT1 (Table 9)

The four sub-samples, each of 100 ml, were selected from the following depths:

48–43 cm	lower silty clay
37–32 cm	lower woody peat
20–15 cm	upper woody peat
5–2 cm	upper silty peat

The nature and composition of both the sediments and the plant remains incorporated within them illustrate local developments at the site. The basal silty clay is water-lain and contains remains of aquatic plants, such as Batrachium (water crowfoot), and wetland plants, including *Polygonum amphibia/minor/mitis* (willow grass) and *Alnus glutinosa* (alder) growing in the immediate vicinity, an area which was probably dominated by alder carr. It also contains fish bones and caddis fly larval cases. At that time, alder carr would also have been a typical place to find *Urtica dioica* (stinging nettle) and *Solanum dulcamara* (bittersweet). The transition to woody peat saw the expansion of alder carr over the actual site. This was maintained for some time before the appearance, first of silt, later of sand and small stones, which bears witness to periods of river flooding. Later, the increased content of inorganic material heralded a return to aquatic conditions in the upper part of the sampled deposits. The latter are very rich in plant remains, ranging from aquatics such as *Ceratophyllum demersum* (hornwort), Batrachium spp., *Potamogeton* (pond weed) and *Zannichellia palustris* (horned pond weed), through marginal vegetation such as *Alisma plantago aquatica* (water plantain), *Iris* sp., *Typha angustifolium* (reed mace/bur reed), Sparganium erectum (bur reed) and *Scirpus* spp (bulrushes), and tall herbs such as *Eupatorium cannabinum* (hemp agrimony) and *Oenanthe aquatica* (water dropwort), to the alder from the carr itself. Small charcoal fragments detected in the lowermost and upper deposits may suggest the proximity of human activity.

Borehole BH1D (Table 10)

As a consequence of being the remains of earlier sub-samples, the two sub-samples were small. They originated from the following depths:

257–256 cm	Black detrital fen type peat (*c* 50 ml)
270–268 cm	Black detrital fen type peat (*c* 20 ml)

The nature of the deposits and the plant macrofossil assemblages reflect local conditions. The material appears to contain both elements of

*Table 9. Section TT1: plant macrofossil analysis. * = further examples seen in fine (0.35 mm) fraction but not picked out; f = fragments.*

Taxa	**Part**	**48-43 cm**	**37-32 cm**	**20-15 cm**	**5-2 cm**
Alisma plantago-aquatica					9*
Alnus glutinosa		2+f	15½+2f	4+f	2f
Alnus glutinosa	male catkins	3½	11	1	
Alnus glutinosa	female cones		1		
Batrachium (*Ranunculus)*		4½*	6½*		20*
Ceratophyllum demersum					2
Eupatorium cannabinum					½
Galeopsis sp					f
Iris sp					f
Lemna sp					2*
Mentha sp			2*		8*
Oenanthe aquatica					ca. 30
cf. *Oenanthe aquatica*					ca. 10
Polygonum amphibia/minor/mitis	*Polygonum amphibia/minor/mitis*	½	½		
Potamogeton sp					9
Ranunculus acris/bulbosus/repens	*Ranunculus acris/bulbosus/repens*				½
Rubus sp		1+3f		1	5+3f
Scirpus sp					1½+f
Solanum dulcamara				1	
Sparganium erectum					2
Typha cf. angustifolium					1*
Urtica dioica		1			
Zannichelia palustris					14*
Additional material					
Charcoal	small fragments	present			present
Moss	shoots		present		present
Buds		1	6		
Budscales		3	4		
Daphnia sp	egg case	2*			2*
Insect fragments			present		present
Fish vertebra & bones		present			
Caddis fly larval case		1			

gyttja (ie water-lain deposits) and peat (ie "terrestrial"). The lower sample is particularly rich in plant remains, dominated by water margin and wetland plants such as *Alisma plantago aquatica* (water plantain), *Rorippa microphylla* (watercress), *Sparganium erectum* (bur reed), *Eupatorium cannabinum* (hemp agrimony), *Typha angustifolium* (reed mace/bur reed) and *Carex* spp (sedges). Alder carr is also still very much in evidence. Again there are charcoal fragments suggesting the presence of human activity.

Charred Plant Remains (Table 11)

Vanessa Straker

A sample for the identification of charred plant remains was taken from the upper fill of the

*Table 10. Borehole BH1D: plant macrofossil analysis. * = further examples seen in fine (0.35 mm) fraction but not picked out; f = fragments.*

Taxa	**Part**	**256-257 cm**	**268-270 cm**
Alisma plantago-aquatica	*Alisma plantago-aquatica*		4*
Alnus glutinosa			6
Apiaceae			4
Batrachium (*Ranunculus)*	Batrachium (*Ranunculus)*		1*
Carex sp (trigonous)		1	11+f
Carex sp (biconvex)			2
Carex sp	utricle		2f
Eupatorium cannabinum	*Eupatorium cannabinum*		1½
Rorippa cf. microphylla			3*
Rumex sp			2
Sparganium erectum		½	1
Typha cf. angustifolium			5*
Additional material			
Charcoal			present
Moss			present
Insect fragments		present	present

Table 11. Section TT2: charred plant remains.

Taxa	**Common name**	**count**
Triticum sp.	wheat	46
Hordeum sp.	barley	25
Secale cereale	rye	3
Secale/Triticum	rye/wheat	6
Avena sp.	oats	2
small indeterminate cereal fragments	small indeterminate cereal fragments	*C 50*
Galium sp.	bedstraw	1
Non-cereal unidentified fragments		6
Total (excluding fragments)		**83**

possible ditch recorded in section TT2. The sample was processed and analysed using standard procedures. The charred grain is radiocarbon dated to early medieval period, 590–780 Cal AD (AA33140).

A total of 83 seeds (excluding fragments) were identified, of which the vast majority are cereals. Wheat (*Triticum* sp.) is most numerous, but as no chaff was preserved this is only identified to genus. Grain morphology is variable with at least half being short and round, suggesting that a free-threshing species such as bread wheat may be represented. There are other grains that are flatter in cross section with a less steeply-angled embryo, more typical of hulled wheat, however, conditions of charring can cause extreme distortion of grains and without the survival of chaff of hulled wheat, its presence remains only a possibility. Of the 25 grains of barley (*Hordeum* sp.), four are hulled straight; nine are hulled twisted; four are hulled and eight are indeterminate. Rye (*Secale cereale*) and oats (*Avena* sp.) also occur, although as florets were not present two grains of oats identified could be wild, weed or domesticated species. The presence of charred cereal grain suggests the proximity of a 7th to 8th century domestic occupation or crop-processing site in the near vicinity.

DIATOM ANALYSIS

Nigel Cameron

Assessment of diatom content was carried out on sub-samples taken from boreholes **BH1D** and **BH4E**, and from sections **1A** and **S1**. Of these, **BH1D** was selected for further analysis as it relates to other archaeological data of local significance, and diatom samples were prevalent in the sub-samples taken from minerogenic sediments laid down in alluvial (and possible lacustrine) conditions. Subsequent detailed analysis was undertaken on 15 samples taken from the lower mineral sediments (six samples from between 276 cm and 296 cm) and the upper silt deposits (nine samples from between 190 cm and 240 cm). Diatoms had not survived within the peat deposits between these mineral sediments. The base of the peat is radiocarbon dated (Table 2) to the Roman period, 70–260 Cal AD (WK16763); the top of the peat to the medieval period, 1020–1250 Cal AD (AA33139).

Diatom method

Diatom preparation followed standard techniques: the oxidation of organic sediment, removal of carbonate and clay, concentration of diatom valves and washing with distilled water. Two coverslips, each of a different concentration of the cleaned solution, were prepared from each sample and fixed in Naphrax, a mounting medium of a suitable refractive index for diatom microscopy. Slides were scanned at magnifications of x400 and x1000 under phase contrast illumination and diatom counting was carried out at a magnification of x1000.

Diatom floras and taxonomic publications were consulted to assist with diatom identification, including Hendey (1964), Hartley *et al* (1996) and Krammer and Lange-Bertalot (1986–1991). Diatom species' salinity preferences are discussed using the classification data in Denys (1992) and the halobian groups of Hustedt (1953; 1957, 199), these salinity groups are summarised as follows:

1 Polyhalobian: >30 g l^{-1} (grammes of salt per litre of water)
2 Mesohalobian: 0.2–30 g l^{-1} (grammes of salt per litre of water)
3 Oligohalobian - Halophilous: optimum in slightly brackish water
4 Oligohalobian – Indifferent: optimum in freshwater but tolerant of slightly brackish water)
5 Halophobous: exclusively freshwater
6 Unknown: taxa of unknown salinity preference

Borehole BH1D (Table 12; Figure 15)

The nine upper samples have relatively poorly preserved diatom assemblages with low species diversity and low concentrations of diatom valves. The main components of many of these samples are aerophilous species (eg *Hantzschia amphioxys*, *Ellerbeckia arenaria*, large *Pinnularia* sp.) tolerant of desiccation. Such poorly preserved assemblages of aerophilous types reflect a semi-terrestrial or ephemeral aquatic environment that was prone to periods of drying out. The inwash of aerophilous soil diatoms may also have contributed to the assemblage. The poor preservation is the result of taphonomic processes, often the result of high sediment alkalinity/acidity, the undersaturation of sediment pore water with dissolved silica, or prolonged dry periods (eg Flower 1993; Ryves *et al* 2001).

Although the low concentrations, poor preservation and low diversity precludes further analysis of this group, the presence of low numbers of allochthonous marine (polyhalobous) and estuarine (mesohalobous) diatoms is noteworthy. These species include *Paralia sulcata*, *Cyclotella striata*, *Coscinodiscus* sp., *Nitzschia navicularis* and *Rhaphoneis* sp. between 201 cm and 208 cm. Their presence may reflect the direct incursion of saline water, or possibly the reworking and transport of fossils from estuarine and marine sediments deposited elsewhere (*cf.* Wentlooge sediments found in the outer Somerset Levels and elsewhere in the inner Severn Estuary). The presence of significant coincident changes in sediment type and pollen assemblages

Table 12 (left). Borehole BH1D: summary of diatom assemblages.

Diatom sample	Depth (m)	Diatom valve concentration	Quality of preservation	Diversity	Assemblage type	Potential for percentage counting	Diatom species
BW1	1.90-1.91	very low	poor	low	aerophile	none	Pinnularia major, Aulacoseira auxoxpore, chrysophyte cysts
BW2	1.93-1.94	very low	poor	low	aerophile	none	large Pinnularia sp. chrysophyte cysts
BW3	2.10-2.02	low	poor	low	aerophile, marine, brackish, fresh	low	Hantzschia amphioxys, chryophyte cysts, Rhaphoneis sp., Paralia sulcata, Ellerbeckia arenaria, Synedra ulna, Cymbella sinuata, Nitzschia navicularis, Coscinodiscus sp., Epithemia sp.
BW4	2.08-2.09	low	poor	low	aerophile, marine, fresh	low	Hantzschia amphioxys, Synedra ulna, Paralia sulcata, Pinnularia brebissonii, chrysophyte cysts
BW5	2.16-2.17	low	poor	low	freshwater	low	Gomphonema angustatum, Pinnularia sp., inderminate pennate fragments, Synedra parasitica, Epithemia sp., Eunotia sp.
BW6	2.24-2.25	low	poor	low	fresh, aerophile	low	Pinnularia sp., Pinnularia viridis, Synedra ulna, Hantzschia amphioxys, cf. Epithemia sp., Eunotia pectinalis, Cocconeis placentula, Cymbella sp., Chrysophyte cysts, Eunotia sp., Gyrosigma sp., Epithemia turgida, Cymbella cf. aspera
BW7	2.32-2.34	low	poor	moderate	fresh, aerophile	low/some	Fragilaria pinnata, Synedra ulna, Eunotia pectinalis v. ventralis, Gomphonema angustatum, Surirella sp., Eunotia pectinalis, chrysophyte cysts
BW8	2.36-2.37	low	poor	moderate	fresh, epiphytes	low/some	Pinnularia sp., Synedra ulna, Epithemia cf. argus, Epithemia cf. turgida, Hantzschia amphioxys, Fragilaria brevistriata
BW9	2.40-2.41	low	poor	moderate	fresh, aerophile	low/some	Aulacoseira sp. chrysophyte cysts, Synedra ulna, Pinnularia sp., Cocconeis placentula, Achnanthes lanceolata, Pinnularia brebissonii
BW10	2.76-2.77	high	good	high	freshwater epiphytic with some benthic spp.	good	Epithemia turgida, E. adnata, E. sorex, E. argus, Cocconeis placentula (&. var. euglypta), Synedra ulna, Eunotia flexuosa, Navicula radiosa, Gomphonema acuminatum (& var. coronata), Melosira varians, Anomoneis sphaerophora, Navicula capitata, Aulacoseira italica type (& auxospores), Navicula pupula, Synedra parasitica, Cymatopleura solea
BW11	2.80-2.81	high	good	high	freshwater epiphytic with some benthic spp.	good	ditto BW10
BW12	2.84-2.85	high	good	high	freshwater epiphytic with some benthic spp.	good	ditto BW10
BW13	2.88-2.89	high	good	high	freshwater epiphytic with some benthic spp.	good	ditto BW10
BW14	2.92-2.93	high	good	high	freshwater epiphytic with some benthic spp.	good	ditto BW10
BW15	2.96-2.97	high	good	high	freshwater with some (non-marine) halophilous spp.	good	Nitzschia hungarica, Melosira varians, Nitzschia levidensis, Cyclotella meneghiniana, Eunotia curvata, Amphora libyca, Achnanthes minutissima, Fragilaria mesolepta, Gomphonema angustatum, Cocconeis placentula, Eunotia pectinalis v. minor, Epithemia sp.

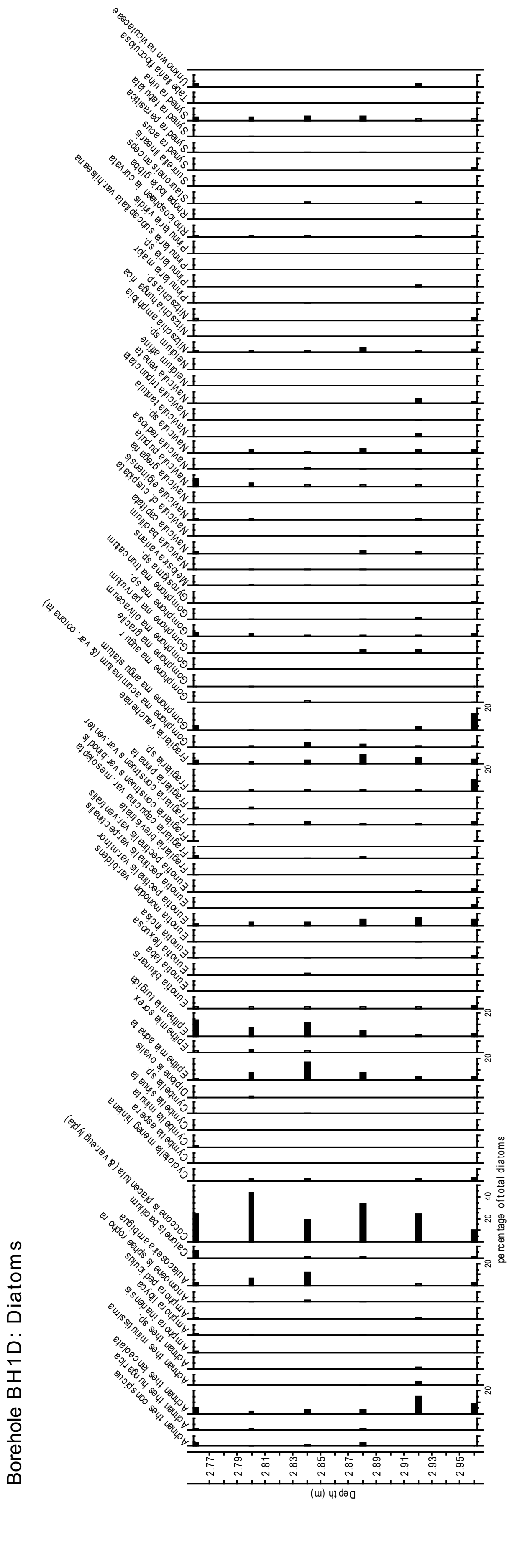
Borehole BH1D: Diatoms
Depth (m)
2.77
2.79
2.81
2.83
2.85
2.87
2.89
2.91
2.93
2.95
percentage of total diatoms
20
40

Figure 15 (left). Percentage diatom diagram from Borehole BH1D.

indicates direct incursion, and phases of inland marine transgression are known from diatom assemblages at sites elsewhere on the Severn Estuary Levels (eg Cameron 1997, Cameron & Dobinson 2000a, 2000b). Preservation and species diversity are slightly better between 216 cm and 240 cm. Marine and estuarine diatoms are absent here and the dominant types are shallow-water, non-planktonic diatoms with many epiphytes (eg *Epithemia* spp., *Cocconeis placentula*, *Achnanthes lanceolata*), benthic diatoms (*Pinnularia* sp., *Navicula radiosa*, *Surirella* sp.) or non-planktonic diatom species that are opportunistic, early colonisers (*Fragilaria brevistriata*, *Fragilaria pinnata*) and some aerophiles (*Hantzschia amphioxys*, *Pinnularia brebissonii*).

The six lower samples have good diatom preservation, with high concentrations of valves and high species diversity (a total of 79 taxa were identified). The overall impression is of one of consistency, with similar ecological types and species composition (Figure 15). However, there is some variation in diatom species abundances between samples. The dominant component of the assemblages throughout the sequence from 276 cm to 296 cm, and consistent with the pollen record, is of freshwater epiphytes with particularly high numbers of *Cocconeis placentula* (maximum 44%, minimum 10%), *Achnanthes lanceolata* (maximum 16%), *Epithemia* (*Epithemia turgida* (maximum 14%), *Epithemia adnata* (maximum 16%), *Epithemia sorex*) and *Gomphonema* (*Gomphonema angustatum* (maximum 14%), *Gomphonema acuminatum*, *Gomphonema parvulum*) species. There are smaller numbers of benthic, mud-surface species. A diatom species of note is *Achanthes hungarica*, the epiphyte of the aquatic macrophyte *Lemna* (duck weed). This diatom occurs in low abundances (present in all six samples, maximum 2%) and is consistent with the pollen record for *Lemna* in this part of the sequence.

It is apparent that the earliest diatom assemblage in the sequence (at 296 cm) is of slightly different composition, although with many epiphytes and benthic species in common with the overlying sediments. Of note are the low numbers of non-marine halophilous diatoms such as the planktonic species *Cyclotella meneghiniana* (maximum 2%), which occurs sporadically but is most common in the basal sample, and other halophiles such as *Nitzschia hungarica* and *Navicula gregaria*.

The only planktonic diatom to reach significant percentages is *Aulacoseira ambigua* (maximum 11% at 284 cm depth). A number of the valves counted were auxospores, suggesting that conditions were not optimal for this planktonic species. This may reflect the shallow nature of the water body or variations in water level that would cause this diatom to enter an auxospore-forming phase. The maximum of *Aulacoseira ambigua* at 284 cm suggests that water depth probably reached a maximum at this time. This species also seems to prefer moderately high nutrient levels.

Diatoms do not show any evidence for nutrient enrichment (eutrophication) for example as a result of the discharge of human or animal waste, or through stagnation. The diatoms reflect only moderate nutrient levels within the range that might be expected in a natural lowland water body. In addition there is a consistent presence of acidophilous (diatoms of acid waters) and oligotrophic (diatoms living in nutrient-poor waters) species, such as the genus *Eunotia*. For example, *Eunotia pectinalis* var. *minor* reaches a maximum of 5% in the basal sample, declining towards the top of the sequence, and *Eunotia incisa* has a maximum of 2% in the basal sample. These acidophiles, which are also halophobous, may represent the contribution to the mixed sediment assemblage of diatom communities from surrounding habitats, such as pools in peat.

Conclusions

The initial phase of the sequence (296 cm to 276 cm) is dominated by shallow-water epiphytes with some benthic elements and little diatom plankton. In the bottom sample, there is some suggestion of slightly higher conductivity but the assemblage is of freshwater species. The middle phase (240 cm to 216 cm) has generally poor preservation, and the diatoms represent shallow freshwater with aerophilous elements. The uppermost sediments have very poorly preserved diatoms and very few valves. These diatoms are all aerophiles. At 208 cm and 201 cm in the uppermost sediments there are marine and estuarine diatoms also present, which probably reflect a contemporary marine transgression.

The diatom evidence (Figure 15) corroborates with the pollen evidence for fen development and a habitat dominated by shallow-water epiphytes. There is a poorly developed freshwater plankton diatom flora that reaches a maximum at 284 cm depth. The presence of plankton auxospores indicates a community under stress, probably as a result of shallow water with variation in water level. However, the high diversity and good quality of the entire diatom assemblage between 296 cm and 276 cm shows that the water body did not dry out. There is no evidence for nutrient enrichment and oligotrophic, acidophilous diatoms indicate the probable inwash of diatoms from peatland.

DISCUSSION

Despite the potential for wide-ranging dates for the various deposits of mineral sediment and peat sampled during the course of fieldwork, all of the dated deposits fell broadly within either the 2nd millennium BC or the 1st millennium AD. The data gained from the studied profiles enable a detailed consideration of the immediate and local environment for these two periods, and allow comment on the contemporary regional environment and pattern of land use. In addition, the recovery of Bronze Age timbers and the recording of Anglo-Saxon features and deposits, along with the historical data from the later Anglo-Saxon period, provide this discussion with two very clear foci: the Bronze Age and the Roman to medieval periods.

The 2nd millennium BC (Bronze Age)

Three profiles were radiocarbon dated to the Bronze Age (Table 2): borehole BH4E, section TT1 and section T1; section 1A is assumed to be Bronze Age by virtue of its close proximity and similarity to borehole BH4E. The oak timber piles and plank from near to Moorside Cottage also date to the Bronze Age.

Chronology

The paired radiocarbon age determinations from the top and bottom of peat deposits from section TT1 and borehole BH4E provide an indication of rates of peat accumulation in the 2nd millennium BC (Tables 2 and 3). The earliest, BH4E, is also the most enigmatic due to the closeness of determinations from the top and bottom of the 44 cm-thick peat deposit. By considering ^{14}C years only, this deposit would have accumulated in only 52 years, from 3637±32 BP (WK16764) to 3585±55 BP (AA33143), giving a compacted sediment accumulation rate of 0.85 cm per ^{14}C year. Calibration appears to separate these dates a little further, with probability peaks at *c* 2020 Cal BC (WK16764) and *c* 1940 Cal BC (AA33143), about 80 years of accumulation at an approximate rate of 0.55 cm per calibrated year. But even at the extremes of 95.4% probability, if peat accumulation commenced in 2140 Cal BC (WK16764) and continued to 1750 Cal BC (AA33143), the accumulation rate is just over 0.1 cm per calibrated year, far greater than recorded elsewhere in the Severn Estuary (see below). Overall, it seems likely that one of these dates is incorrect. Although more pollen zones were identified in section TT1 there is a good deal of conformity in the two profiles, suggesting that AA33143, from the top of the peat, is anomalous, and that all three profiles are broadly contemporary.

The data from section TT1 indicate a much slower rate of accumulation. Dating from 3636±43 BP (WK16612) to 2925±70 BP (AA33142), the 0.32 m-thick peat deposit in Section TT1 formed at a rate of 0.045 cm per ^{14}C year. This is similar to accumulation rates for the 2nd millennium BC calculated elsewhere in the Severn Estuary, for example at the International Rail Freight Terminal, Wentlooge, Cardiff, where peat accumulation rates of 0.02 cm per ^{14}C year and 0.06cm per ^{14}C year were calculated (Walker *et al* 2002, 118). However, in any discussion of rates of peat accumulation, the affect of differential compaction must be considered. There are many factors that may affect how peat is compacted and it has been suggested that, under certain circumstances, the compaction of peat may be as high a 90% by volume (Shennan *et al* 2000). Clearly differential compaction of such magnitude would render any consideration of peat accumulation void.

Environment

Profile TT1 has been examined in greatest detail for pollen and macroscopic plant remains (Tables 6, 9 and 11; Figures 10 and 11), but there is a great degree of conformity in the findings of these analyses with the profiles obtained from BH1E (Table 4; Figures 8) and 1A (Table 5; Figures 9). Whilst pollen provides information on the character of the regional Bronze Age vegetation, the plant macrofossils (largely seeds/fruits) provide a more detailed record of the autochthonous vegetation, which is backed by the pollen data. Local sedimentary environmental conditions changed during the middle Bronze Age, resulting in a phase of peat accretion (Zones TT1.2 and TT1.3) between 2140–1890 Cal BC (WK16612) and 1370–920 Cal BC (AA33142). This occurred after the deposition of silty clays in a wetter aquatic/marsh habitat, which contained a wide range of aquatic and wetland fen plants with alder carr probably growing on site or in close vicinity (Zone TT1.1). Pollen data confirm this and also show presence of willow, which was probably associated with the alder carr woodland. Pollen also demonstrates that the nearby interfluves had woodland of oak and hazel with some lime and ash, the latter possibly more important than the actual pollen numbers imply. The presence of lime woodland and its dominance (or at least co-dominance) with oak is now widely evidenced from southern and eastern England for the middle Holocene (Atlantic period) and the late prehistoric period prior to the well documented 'lime decline' (Birks *et al* 1975; Moore 1977; Scaife 1980, 2000, 2003; Greig 1982). Ash (*Fraxinus excelsior*) is similarly well documented for the Neolithic period when it became important as a secondary woodland coloniser in areas left after the 'elm decline' (Scaife 1988). Charcoal fragments in the lower silts of Zone TT1.1, with cereal pollen and associated weeds, suggest human activity/interference and agriculture in an otherwise partially wooded landscape on the drier interfluves. Grasses, ribwort plantain and other pollen taxa also suggest grassland, possibly pasture, implying a mixed agricultural economy during the early and middle Bronze Age.

The presence of oak woodland nearby at the beginning of the 2nd millennium BC is corroborated by the recovery of a large group of buried oak trees from Higher Salt Moor, less than half a kilometre to the north of Athelney Hill, during drainage works in 1998 (Tyers 2007). One timber was radiocarbon dated to 3500±60 BP (Beta-151871), which calibrates to 2010–1680 Cal BC, and subsequent dendrochronological analysis has produced a 190-year composite sequence constructed from 17 cross-matched samples dated 2013 BC to 1824 BC (*ibid.*, 1, 4). Almost all of the samples contain lengths of anomalously narrow rings, and several have anomalously high numbers of sapwood rings, both probably caused by changes in drainage conditions creating increased stress, or on occasion releasing distressed trees (*ibid.*, 5–6). These observations cannot be directly related to environmental changes inferred from the Baltmoor Wall sections, but provide further evidence for the area's changing environment of the area during the early 2nd millennium BC.

From *c* 2140–1890 BC, the on- or near-site alder carr definitely became on-site, from the presence of alder catkins, cones and wood (Zone TT1.2). This is also evidence in BH4E which also contains substantial quantities of alder pollen (Zone BH4E.1). Stratigraphically this is manifested by a change from silty clays to wood peat, with less aquatic plants but containing seeds of other fen taxa (Batrachium, *Mentha* and *Polygonum amphibium/minor/mitis*). This environment was stable for sometime with alder/willow carr woodland on site, with willow becoming dominant in the upper peat levels (Zone TT1.3). *Polypodium vulgare* (common polypody fern) was also growing on these trees, indicating this stability. Stratigraphically, however, there is also evidence of increasing wetness from the increasing content of mineral sediment. TT1.4: This is a prelude to widespread sediment alluviation in the late Bronze Age and Iron Age, usually attributed to regionally rising base-levels brought about by positive eustatic change at this time. Alternatively, at Baltmoor Wall this may have been due to the climatic deterioration at the start of the Iron Age, which lasted throughout the 1st millennium BC (Rippon 1997, 43), with the increasing mineral sediment a result of increased precipitation.

This ultimately saw a cessation of wood peat formation (Zone TT1.4) in the late Bronze

Age, at 1370–920 Cal BC, and a return to aquatic conditions with development of sedge/reed fen with areas of open water. Assuming the top of peat date in BH4E (AA33143) is incorrect, a comparable sequence is apparent from pollen and seeds of sedges, reed mace/bur reed, iris, arrow head and water plantain. Aquatic macrophytes are also present showing open, shallow water including pond weed, horned pond-weed, yellow and white water lily and hornwort. Contemporaneously, oak and hazel woodland remain important on drier ground, and there is a marked increase in herbs brought about by the changing taphonomic conditions, pointing to an increased pollen catchment with fluvially transported pollen. Also in Zone TT1.4/BH4E.2 there are increased numbers of cereal pollen grains and associated herbs attesting to arable agriculture, probably at a distance but within the now extended catchment. This also reflects the greater occurrences of cereal pollen in the lower sediments (Zone TT1.1 underlying the peat) and, as with this lower zone, the presence of charcoal which may also be attributable to human activity.

Archaeology

The Bronze Age wooden piles and plank recovered from a spoil heap near to Moorside Cottage, radiocarbon dated to 1370–1010 Cal BC, are yet further examples of the important waterlogged prehistoric structural timbers that survive within the peat moors of the Somerset Levels. It is unclear if these timbers once formed part of a trackway, perhaps crossing from East Lyng to Athelney, although if so they are certainly not associated with the bridge or causeway of the late 1st millennium AD. Numerous other prehistoric trackways are known from the Levels, particularly from the area of Shapwick Heath to the north-west of Glastonbury, including the Neolithic ‘Sweet Track’, the ‘Abbot’s Way’, the ‘Eclipse’ track, and the ‘East Moors’ trackway (Brunning 2000), all of which pre-date the Baltmoor Wall timbers by at least 500 years. It is also possible that the timbers were part of a timber pile alignment akin to that investigated at Greylake on King’s Sedgemoor, to the east of Middlezoy, which dated to the late Bronze Age and included planks, wood chips, human and animal bone, pottery and a socketed axe amongst the wooden piles (Brunning 2000, 70–1).

The environmental evidence indicates an increased wetness of the area (and region) in the late Bronze Age, as willow carr was becoming diminished as a retrogressive hydrosere was in progress, with development of wet grass/sedge/reed fen and areas of standing open water. The construction of a wooden trackway from Lyng to Athelney may have been in direct response to the rising water levels, to maintain access across to the ‘island’ across a densely vegetated, wet, and probably largely impenetrable fen woodland. Other late Bronze Age trackways, perhaps constructed as a result of the same phenomenon, include those at Langacre Rhyne, Greylake, dating to 790 BC (PRN 10580), at Caldicot on the Gwent Levels, dating to 991 BC, and at Skinner’s Wood, Shapwick, dating to 982 BC (Brunning 2000, 72).

The environmental evidence for the wetter, non-peat deposits of the early-middle Bronze Age and the later Bronze Age attests to human activity, albeit from a wide catchment area, through pollen evidence for arable (and possibly pastoral) agriculture, and possibly from charcoal fragments too. It seems likely that the Isle of Athelney was not being ‘farmed’ during the Bronze Age, although certainly this was occurring elsewhere in the vicinity, but was forested and certainly visited, as attested by antiquarian discoveries of two Bronze Age palstaves on the slopes of the hill, the exact provenance being unknown (PRN 10555).

The 1st millennium AD (Roman and early medieval)

Two profiles were radiocarbon dated to the Roman/medieval period: borehole BH1D and section S1, although the latter comprised only a thin layer of peat dating to the late Roman period. Profile BH1D is of significance because it potentially has data pertaining to land use associated with the historical evidence for late Anglo-Saxon activity on Athelney Hill (see above). Also of significance are the remains revealed at the bottom of Trial Trench TT2, which comprised a low bank and probable ditch dating to the early medieval period.

Chronology

The paired radiocarbon age determinations (Tables 2 and 3) from the top and bottom of the peat deposit in borehole BH1D give an indication of the rate of peat accumulation in the 1st millennium AD. Dating from 1839±39 BP (WK16763) to 900±50 BP (AA33139), this 0.38 m-thick peat deposit accumulated at a rate of 0.04 cm per ^{14}C year, a value remarkably consistent with that obtained from the Bronze Age deposits in section TT1. Again, the effects of differential compaction must be considered (see above), which may account for only a very thin layer of peat surviving beneath the weight of Baltmoor Wall in section S1 (Figure 5).

Environment

Profile BH1D (Tables 8, 10 and 12; Figures 13, 14 and 15) was examined in detail as it (partly) relates to historic events at Athelney, and has produced useful information on this period which follows on from the late prehistoric sequences described above. The BH1D sequence embraces a lower sedimentary unit overlain by peat, in turn suceeded by floodplain alluvial deposits. Radiocarbon measurements of the intercalated peat produced dates of 70 to 260 Cal AD (WK16763) for the base and 1020 to 1230 Cal AD (AA33139) at the top. The underyling and overlying sediments fall outside this date range, thus extending the temporal span of the profile. However, it is unclear how rapidly the mineral sediments accumulated.

The BH1D sequence is one of a growing number of known peat deposits from the Somerset Levels with radiocarbon dates relating to the Roman and/or medieval periods, which partly refute a previous assumption that peat growth ceased sometime around AD 400 (Housley *et al* 2007, 13–14). Other peat deposits in the vicinity have yielded early medieval dates from West Sedgemoor 1 (1521±64 BP, calibrated to 410–650 Cal AD; WK11909) and from Oath Lock Sluice, Kings Sedgemoor (1345±39 BP, calibrated to 620–780 Cal AD; WK15500), and a sample from West Sedgemoor 2 (203±40 BP, calibrated to 1640–1960 Cal AD; WK11908) shows that peat formation continued at least until the time of the parliamentary enclosures (*ibid.*, 14–15).

With profile BH1D there is again a close correspondence between data obtained from pollen, diatoms and plant macrofossil samples. The pollen has been analysed throughout the sediment sequence and provides the longest temporal record of vegetation and environmental change. Diatoms come from the lower and upper sediments whilst plant macrofossils were extracted from the peat. The lower sediment unit (Zone BH1D.1) contained abundant and well preserved diatoms with a diverse range of types largely dominated by freshwater epiphytes with small numbers of benthic taxa, which live on mud surfaces. These data correspond with the results of pollen analysis, which also suggest a freshwater habitat with aquatic megaphytes such as duckweed and pond weed, with fringing reed swamp communities containing species such as sedges, water plantain, purple loosestrife, arrowhead and especially reed mace and bur reed. Diatoms indicate that this was a freshwater habitat but that it was perhaps shallow or unstable. Diatoms are useful in determining salinity and nutrient enrichment caused by pollution by human or animal waste. In the lower levels there are no indications of either, with the water being of moderate eutrophic status but with a small number of acidophilous taxa from more acid peaty areas.

Overlying the lower sediments of freshwater derivation are humified peats which clearly show a drying out of the local habitat (Zones BH1D.2 and BH1D.3). Pollen data suggest a local habitat woodland of oak and hazel, and possibly birch. The on-site habitat became a drier grass sedge-reed fen, with marsh ferns and willow later. The plant macrofossils confirm this with the presence of water margin and wetland plant taxa including water plantain, lesser reed-mace, bur reed and water cress. Macrofossil evidence also shows some alder although this is not so apparent in the pollen record.

At 1020–1250 Cal AD, the peat-forming habitat was subject to a major environmental change. The detrital peat of Zone BH1D.3 gives way to a thick layer of alluvial silt (Zones BH1D.4 and BH1D.5). It is not clear what caused this but it resulted in a floodplain alluvial environment, the vegetation probably dominated by rough floodplain grassland pasture. Although diatoms were poorly preserved in these alluvial sediments, many aerophilous diatom taxa were found substantiating that the habitat was probably floodplain in that these species reflect a semi-terrestrial habitat or ephemeral aquatic habitat which was prone to periods of drying out. It is possible that this change took place as a result of progressive, positive expansion of relative sea level (regionally), which ponded back river systems causing overbank flooding. The presence of allochthonous marine (polyhalobous) and estuarine (mesohalobous) diatoms in these upper sediments may reflect the direct incursion of saline water, although the 15 km distance from the coast is considerable. The historical record indicates that the monks of Athelney were, by the 12th century, engaged in water management, which also could easily been responsible for increased wetness in local depositional environments, especially if coupled with intensified or changed land-use on the interfluves giving rise to greater erosion and transport of sediment into the system. The presence of marine and estuarine diatoms could also be from the reworking and transport of fossils from much earlier estuarine and marine sediments deposited elsewhere.

Of note in Zone BH1D.5 is the presence of small numbers of mesohalobous and polyhalobous diatom taxa. These probably represent ephemeral incursions of saline, brackish water at times of highest tidal ingress, or in storm surges. Such diatom evidence for occasional saline ingress has also been recorded in the BH4E sequence from these upper alluvial silts and here there is some pollen evidence for salt marsh halophytes (Chenopodiaceae) which may derive from inwashed pollen from salt marsh communities. Although probably a result of occasional marine flooding, it is possible that these diatoms are derived from the transportation of material eroded from the Wentlooge Formation clays and silts widespread in the outer Somerset Levels and along the Severn Estuary. This geological formation of the Holocene contains marine and brackish water diatoms (Cameron 1997; Cameron and Dobinson 2000a, 2000b) and pollen (Scaife 2002a, 2002b), and potentially could have contributed to the pollen and diatom flora through erosion, transportation and re-deposition at this site.

The general absence of pollen evidence for trees throughout profile BH1D, but with a consistent background vegetation of oak and hazel, is typical for the medieval period in southern Britain. These species clearly remained important, probably from managed woodland. There is pollen evidence for arable agriculture throughout the profile, with wheat/barley and rye, albeit in frequently small numbers. The decrease in cereal pollen from Zone BH1D.1 (with a wide, fluvial catchment area) to Zones BH1D.2 and BH1D.3 (with a more local depositional environments) suggests that arable agriculture was not occurring in the immediate vicinity during the Roman and early medieval period, the increased numbers for Zones BH1D.4 and BH1D.5 may again be a result of a wider fluvial catchment area. The dominance of wheat and barley within the collection of charred grain recovered from trial trench TT2 is probably linked to a nearby settlement (below), but the grain could easily have been imported from elsewhere. Pollen evidence for pastoral agriculture is problematic since grasses are catholic, but the presence of pasture weed species such as ribwort plantain, docks and daisies in Zones BH1D.1–3 are suggestive of local pastoral agriculture in the Roman and early medieval periods. The substantial increase in dandelion in Zone BH1D.4, the upper alluvial silts of the later medieval period, may also be evidence for increased pasture, although this may also be due to its relative robustness in the poorer preserving conditions. The diatom data do not show any evidence for nutrient enrichment (eutrophication) for example as a result of the discharge of human or animal waste, or through stagnation.

Archaeology

One of the most significant discoveries during the course of the project was the presence of the bank and probable ditch within Trial Trench 2, both of which date to the early medieval period. The presence of a 6th to 7th-century bank represents the earliest-dated archaeological feature yet discovered on Athelney Hill. Apparently running east to west along the southern edge of the hill, the purpose of the low bank is unclear; it may have been part of an early water management system, an enclosure boundary, or even (if originally taller) for defensive purposes. The presence of a probable ditch, apparently north/south aligned and filled in during the 7th or 8th century, suggests that additional drainage was then required, possibly as a result of the construction of the bank itself. The charred grain recovered from the upper fills of the ditch indicates contemporary settlement, probably on Athelney Hill itself, although the precise location is unknown.

Both features clearly pre-date Alfred's associations with Athelney in the late 9th century, and relate to an earlier (and quite possibly pre-Saxon) occupation of the island. The substantial colluvial deposits overlying the bank and infilled ditch are also of significance, suggesting that a considerable amount of erosion took place sometime after 590–780 Cal AD (AA33140) once the bank and ditch had fallen out of use. Although the pollen evidence regarding arable agriculture on Athelney Hill in the early medieval period is inconclusive, the presence of so much colluvially derived material post-dating the recorded features strongly suggests intense arable farming leading to substantial soil erosion in the later Saxon period, most likely associated with the establishment of Athelney Abbey.

The 2nd millennium AD (later medieval to modern)

Despite its location at the end of Baltmoor Wall, the early medieval low bank clearly pre-dated the later structure by several centuries, and was not directly associated. Pottery recovered from below Baltmoor Wall in section S1 (Figue 5), apparently from an infilled palaeochannel, indicates a 14th or 15th-century date (at the earliest) for the original construction of the extant flood defence embankment. This tallies well with Williams' (1970, 59) suggested construction date of the later 14th century for Baltmoor Wall, derived from historical sources (see *historical and archaeological background* above). The medieval bank comprised clean silty clay and survived to a height of 1.75 m. It was unclear if the overlying stonework and its associated clay bedding deposits dated to the late 17th-century or, perhaps more likely, to the late 19th-century phase of construction. The modern silt deposits to either side of Baltmoor Wall relate to works carried out by the National Rivers Authority in the 1990s (Collings *et al* 1996, 7).

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